Health and Safety Guidelines

Laboratory Safety Manual

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SCU Laboratory Safety Guidelines

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Preface

Southern Cross University would like to acknowledge the contribution of University of Western Sydney in the development of this manual.

These guidelines have been designed to be used most effectively in an interactive format on-line. When accessed electronically, direct links are provided throughout the document for various internal and external references and sites. These links are underlined and are in blue font.

This manual has been developed using the Work Health and Safety Act 2011

Please note these guidelines make reference to Australian Standards, particularly, *AS/NZS2243* Safety in Laboratories. This document is held in the Workplace Health and Safety Office and can be viewed as required.

1 Introduction

The purpose of these Guidelines is to provide practical WHS guidance for all who may be required to visit, work or learn in any laboratory that is under the control of Southern Cross University.

The Guidelines have been developed to complement other risk management information contained in:

- Australian Standards that are applicable to the design, construction, maintenance and safe operation of laboratories as amended
- SafeWork NSW, Worksafe QLD publications and Codes of Practice applicable to safety within laboratories

The University recognises that certain key stakeholders can, more so than others, have a significant impact on establishing, implementing and maintaining safety standards within laboratories.

The content of these Guidelines therefore, is especially directed to:

- Heads of Work Units
- Academics with teaching, unit/site coordination, supervisory and/or managerial responsibilities
- Casual Academic Staff
- Researchers and research supervisors
- Technical Managers
- Technical Staff (permanent and casual)
- Facilities Staff responsible for overseeing the design, construction and maintenance of laboratories and associated facilities
- Undergraduate, Honours and Postgraduate Students
- Visitors
- Contractors engaged by the University to undertake work within a laboratory

As these Guidelines cover basic laboratory safety requirements it is expected that individual Work Units will develop and implement local safety instructions that are designed to meet their specific needs but remain compatible with these guidelines.

It should be noted that there may be a need for exclusion from certain requirements of these Guidelines by certain laboratories and/or associated facilities. These exclusions should be determined by each individual Work Unit by the risk management process, and then be communicated to all relevant persons and documented in local safety instructions and procedures.

2 Glossary

Academic	A person who is required to undertake a teaching, course coordination, unit coordination and/or local unit coordination role as part of the delivery of an academic program.
Act	Work Health and Safety 2011
Advisory Body	A reputable body which has been formed for the purpose of providing reliable and impartial advice and assistance to employers, employees, government, unions or other interested parties.
Australian Standard	A document published by Standards Australia for the purpose of establishing national benchmarks for products and services so as to enhance quality of life and industry efficiency. Australian Standards are advisory but can be cited under legislative arrangements as legal standards of compliance.
Facilities Management &Services	The work unit within SCU responsible for overseeing the design, building, maintenance and upkeep of all property infrastructure that is occupied by the University.
Casual Academic	A person who is employed by the University on a casual basis to teach in laboratory practicums as an academic supervisor or demonstrator.
Chemical spill	A chemical spill is taken to have occurred when any quantity of chemical drops, leaks, overflows or by any other means touches any place other than the place intended for the chemical.
Code of Practice (CoP)	An advisory document developed for the purpose of assisting employers and employees to meet legal requirements under specific Federal or State legislation. Codes of practice can be regarded as stand-alone documents or can be approved under legislation. Failure by an employer to comply with a recognised code can constitute a prima facie case that the duty of care has not been fully met.
Contractor	An organisation (company) or person engaged by the University under a contract for service to undertake work and/or provide a service on a 'one off' or as part of a contract agreement.
Course Coordinator	An **academic** who has the overall responsibility for the development and design of a course in consultation with **unit coordinators.**
Duty of Care	An employer's legal responsibilities under the *Act* for the occupational health and safety of employees. At law these responsibilities are flexible and complex, are not transferable and arise out of a contract of service. Employees have a responsibility to take reasonable care of the health and safety of themselves and others, and must cooperate with employers in their efforts to comply with requirements of the *Act*.
Genetically modified organism (GMO)	An organism that has been genetically modified and is regulated under the *Gene Technology Act 2000* and the *Gene Technology Regulations 2001*
Hazard	A characteristic that is inherent in the work or has the potential to cause death or injury to persons and/or interrupt or interfere with the work process or activity.
Hierarchy of Control Principle	A list of control measures, in priority order that can be used to eliminate or minimise exposure to hazards.
Joint Consultation	A process of consultation between the university and employees regarding health and safety matters of mutual interest with a view to negotiating an agreed outcome.
Laboratory and	A building or any part of a building that is used or may be used for practical or

Associated Facilities	scientific work or processes. Associated facilities include support areas such as preparation areas, instrument rooms, workshops and stores.
Laboratory Staff	Staff who manage, work in and/or have responsibility for a laboratory(ies) and/or associated facility(ies) e.g. Technical Manager, Technical Staff, Researcher or Research Supervisor. At certain times may also refer to academic staff supervising practical classes in laboratories.
Safety Data Sheet (SDS)	A SDS is a document provided by manufacturers and suppliers describing the properties and uses of a substance including its chemical and physical properties, potential hazards to health, precautions for use, first aid requirements and emergency procedures. A SDS for each substance should be available to all staff and students using that particular substance.
Must	Means mandatory i.e. non-negotiable, either because SCU is obliged by statute or it is the policy of SCU.
Needlestick injury	An injury caused by a sharp object, such as a needle or scalpel blade, penetrating the skin. If the sharp object is contaminated by blood, blood products, or body fluids of human origin, there is a risk of transmission of blood-borne infections such as hepatitis B and HIV.
Post Graduate Work	Work undertaken in a laboratory or associated facility by a higher degree research student completing honours, masters or doctoral studies. This work is usually conducted under the supervision of the **Research Supervisor.**
Practicum	Experimental, practical or scientific work undertaken in a laboratory or associated facility that requires a risk assessment to be conducted before work can proceed. Such work may include use of chemicals, biological materials, radiation, machinery and electrical or mechanical processes.
Personal Protective Equipment (PPE)	Equipment that must be worn by persons who enter, work or learn in laboratories and associated facilities. The type of PPE required will be determined by the nature of the work and the risk management process.
Regulation (in law)	A type of delegated legislation, including such legislation designed to regulate particular hazards e.g. radiation, equipment (e.g. cranes), processes (e.g. welding) or workplaces (e.g. laboratories).
Researcher	Primary person involved in research that is undertaken by, at or on behalf of SCU in any of its laboratories or associated facilities. Researchers have a responsibility to implement measures to ensure the safety of all those associated with the research.
Research Work	Work that specifically involves research that is conducted in a SCU laboratory(ies) or associated facility(ies).
Risk	The degree of probability of injury or loss given a defined set of circumstances.
Risk Management	The process of identifying, quantifying and prioritising potential risks and their associated losses, and developing cost effective management strategies to assume control of or eliminate these costs or losses.
Should	Means recommended but not mandatory i.e. ought to be done but need not be followed if a safer alternative is available and is practical given circumstances prevailing at the time.
Source material	Material that, following an investigation, is taken to have been the material that is the sole cause of injury, illness or damage due to contact, contamination, inhalation or other form of exposure.
Standard Precautions (formerly Universal	Precautions designed to reduce the risk of injury, illness, contamination or infection when handling human blood and body fluids or other materials contaminated with these. Standard precautions should be used to develop

Precautions)	Safe Work Procedures appropriate to the type of work or learning carried out within a laboratory or associated facility. Refer to *NOHSC:2010(2003)* and *NSW Department of Health Infection Control Policy* and SCU Policy.
Safe Work Procedures	Safe Work Procedures (SWPs) are written instructions that outline the safest and most preferred method of undertaking a particular task, work practice, process, manipulation, or technique, (including operation of machinery or equipment). They should include all potential hazards associated with the task, the risks posed by these hazards and the appropriate control measures required to eliminate or reduce the risks. Their purpose is to ensure the safety, quality and uniformity of a task among different people.
Statutory Duty	A legal obligation owed under legislative arrangements.
Systems of Work	The totality of the methods adopted for carrying out the operations required in a particular workplace. It covers all facets of the employment situation, including the organisation of work processes, the methods of using plant and equipment, job training and instruction about aspects of safety in the workplace.
Technical Manager	The person who has overall responsibility for overseeing the day to day management of a **laboratory(ies) and associated facility(ies).**
Technical Staff	University staff undertaking work within a laboratory who report to a Technical Manager.
Visitor	A visitor is any person not permanently authorised by the University to be in, work or learn in a particular laboratory or associated facility.
Safe Work Australia	The administrative/business arm of the Office of the Australian Safety and Compensation Council (formerly the National Occupational Health and Safety Commission -NOHSC).
SafeWork NSW / WorkSafe QLD	A statutory authority whose primary objective is to work in partnership with their respective community to achieve safe workplaces, effective return to work and security for injured workers.

3 Responsibilities

Whereas the responsibility for implementation of these Guidelines primarily rests with the management of the University it is recognised that Health and Safety Representatives (HSR) are well placed to provide advice and feedback on the:

- appropriateness of the material contained in the Guidelines
- effectiveness of the risk control measures outlined in the Guidelines when applied to the work being carried out within a laboratory setting
- practicalities of implementing the Guidelines within laboratories, and how well these constructive recommendations improve workability and layout of a laboratory and associated facilities.

3.1 All Staff (permanent and casual) and Students

Staff and students who are required to undertake work and/or learning in laboratories are to comply with these Guidelines.

Failure to comply with these Guidelines may result in disciplinary action being taken by the University.

Staff and/or students must take personal responsibility for ensuring their own safety and the safety of others by:

- taking the action(s) necessary to eliminate or minimise any hazards over which they have control;
- complying with safety instructions, policies, and procedures including departmental safety manuals;
- have completed the appropriate laboratory safety induction and training to enable them to undertake their work safely;
- making proper use of all safety devices and personal protective equipment;
- complying with the instructions given by emergency response personnel such as emergency wardens and first aiders;
- not wilfully placing at risk the health and safety of any other person;
- seeking information or advice where necessary before carrying out newor unfamiliar work;
- maintaining dress standards appropriate for the work being done. Appropriate protective clothing and footwear must be worn at all times;
- only consuming or storing food and drink in designated areas;
- being familiar with emergency and evacuation procedures and the location of, and if appropriately trained, the use of, emergency equipment;
- reporting all incidents, hazards and 'near miss' incidents on the SCU Incident, Accident & Hazard Report Form.

3.2 Heads of Work Units

Heads of Work Units are primarily responsible for ensuring that the occupational health and safety standards and practices spelled out in these Guidelines are fully implemented and followed within laboratories and associated facilities.

To achieve compliance with these Guidelines, Heads of Work Units should ensure that:

- Academics, Academics with Course and/or Unit coordination responsibilities and Technical Managers have resources to develop, implement and monitor the strategies, systems and procedures necessary to ensure that these Guidelines can be fully implemented;
- Academics and Technical Managers within Work Units fully implement the Guidelines within laboratories under their control and monitor compliance

- staff and students receive the appropriate information, instruction and training necessary for them to learn and work in accordance with the Guidelines;
- any behaviour on the part of any person that amounts to a failure to comply to these Guidelines is dealt with in accordance with University's disciplinary policies and procedures (refer to SCU Code of Conduct).

3.3 Academics (Course and/or Unit Coordination)

Academics with course and/or unit coordination responsibilities are required to ensure that:

- academics with teaching responsibilities are made aware of and are fulfilling the WHS responsibilities set out in Section 3.4 below;
- casual academics with supervisor or demonstrator responsibilities are made aware of and are fulfilling the WHS responsibilities set out in Section 3.5 below;
- course and Unit outlines contain a specific reference to and information about how to access a copy of these Laboratory Guidelines;
- they conduct a formal risk assessment in conjunction with the design, development and implementation of any practicum(s) that are included as part of the learning;
- they make available a copy of all risk assessments relevant to the practicum(s) to all academics or casual academics, and technical staff, who are involved in the preparation, teaching, supervision and/or demonstration of the practicum.

3.4 Academics (permanent or casual) with teaching responsibilities

Academics who are responsible for the teaching of the learning outcomes contained in a Course or Unit Outline are required to ensure that:

- they are familiar with all formal WHS risk assessments applicable to any practicum(s) that are included as part of the learning and ensure that all control measures are implemented;
- their chosen method(s) of achieving the learning outcomes do not lead to a contravention of these Guidelines;
- hazardous wastes and materials are disposed of appropriately;
- students have received the appropriate laboratory safety induction to enable them to undertake their learning safely;
- students are formally advised that failure to comply with these Guidelines may result in disciplinary action being taken by the University;
- students have access to and wear the personal protective equipment required to undertake their learning safely ;
- students are formally advised that unauthorised experimentation is strictly forbidden;
- students are formally advised that they are required to take personal responsibility for ensuring their own safety and the safety of others.
- all incidents, hazards and 'near miss' incidents are notified to the Technical Manager and reported using the SCU Incident, Accident & Hazard Report Form, and a copy sent to the relevant Head of Work Unit;

3.5 Researchers

Researchers are the primary persons involved in research projects and as such have a responsibility to implement measures to ensure the safety of all those associated with the research. In particular researchers are required to ensure that:

- they fulfill their responsibilities as outlined in the Australian Code of Conduct for the Responsible Conduct of Research Policy and Procedure;
- staff and students associated with the research are made aware of and are fulfilling their WHS responsibilities;

- they conduct formal risk assessments on all work that is included as part of the research program and ensure that all control measures are implemented;
- staff and students associated with the research have received the appropriate laboratory safety induction and training to enable them to undertake their work safely;
- staff and students associated with the research are formally advised that failure to comply with these Guidelines may result in disciplinary action being taken by the University;
- staff and students associated with the research have access to and wear the personal protective equipment required to undertake their work safely ;
- all incidents, hazards and 'near miss' incidents are reported using the SCU Incident, Accident & Hazard Report Form, and a copy sent to the relevant Head of Work Unit or Research Centre;
- staff and students associated with the research are formally advised that unauthorized experimentation is strictly forbidden and any new work must not proceed until a formal risk assessment is conducted;
- staff and students associated with the research are formally advised that all original/raw research data is the property of the University and must be kept in accordance with the Australian Code of Conduct for the Responsible Conduct of Research Policy and Procedure;
- staff and students associated with the research are formally advised that they are required to take personal responsibility for ensuring their own safety and the safety of others.

3.6 Research Supervisors

A research supervisor of honours and postgraduate students is required to ensure that:

- they fulfill their responsibilities as outlined in the Australian Code of Conduct for the Responsible Conduct of Research Policy and Procedure;
- students are made aware of and are fulfilling the WHS responsibilities set out in Section 3.12 below;
- in conjunction with their students, they conduct formal risk assessments on all work that is included as part of the postgraduate research program and ensure that all control measures are implemented;
- students have received the appropriate laboratory safety induction and training to enable them to undertake their work safely;
- students are formally advised that failure to comply with these Guidelines may result in disciplinary action being taken by the University;
- students have access to and wear the personal protective equipment required to undertake their work safely ;
- all incidents, hazards and 'near miss' incidents are notified to the research supervisor and reported using the SCU Incident, Accident & Hazard Report Form, and a copy sent to the relevant Head of Work Unit;
- students are formally advised that unauthorized experimentation is strictly forbidden and any new work must not proceed until a formal risk assessment is conducted with the supervisor;
- students are formally advised that all original/raw research data is the property of the University and must be kept in accordance with the Australian Code of Conduct for the Responsible Conduct of Research Policy and Procedure;
- students are formally advised that they are required to take personal responsibility for ensuring their own safety and the safety of others.

3.7 Technical or Laboratory Managers

Technical or Laboratory Managers are required to ensure that:

- effective strategies, systems and procedures are developed, implemented and monitored to ensure that work and learning in laboratories is undertaken strictly in accordance with these Guidelines;

- the Technical Staff they supervise receive the appropriate information, instruction, laboratory safety induction and training to carry out their work in accordance with these Guidelines;
- risk assessments are conducted, documented and maintained for all hazardous substances and dangerous goods under their control and for the work conducted by any Technical Staff they supervise;
- the Technical Staff they supervise are fully conversant with these Guidelines and understand their role in monitoring compliance;
- a failure on the part of any person to comply with these Guidelines is reported to the Head of Work Unit;
- work relating to the (re)design, modification, repair and/or upkeep of a laboratory or facilities is undertaken in a manner that does not compromise the safety of person(s) or property or contravene these Guidelines;
- appropriate emergency management plans are developed, implemented and regularly tested;
- staff and students are trained in what action(s) they must take should an emergency arise within a laboratory;
- students have received the appropriate laboratory safety induction prior to commencing laboratory work;
- staff and students have access to and wear the appropriate personal protective equipment whilst in a laboratory;
- students are formally advised that they are required to take personal responsibility for ensuring their own safety and the safety of others;
- effective protocols are developed, implemented and monitored for the handling, storage, transport and disposal of hazardous equipment, materials, substances and wastes;
- all incidents, hazards and 'near miss' incidents are reported using the SCU Incident, Accident & Hazard Report Form and a copy sent to the Head of Work Unit.

3.8 Technical Staff (permanent and casual)

Technical Staff are required to:

- monitor compliance with these Guidelines within their work area(s) and report instances of non-compliance to the Technical or Laboratory Manager;
- establish, monitor and maintain appropriate levels of hygiene and housekeeping within laboratories and preparation rooms;
- assist academics to implement the risk control measures they have outlined in their course/unit risk assessments;
- in consultation with the Technical or Laboratory Manager conduct risk assessments on the work that they perform in the laboratory (e.g. equipment setup, practical class preparation, waste disposal etc);
- regularly check, test and document the serviceability of specific laboratory emergency equipment not under the control of Facilities Management & Services;
- oversee the proper segregation, storage and disposal of hazardous wastes;
- clean, prepare, isolate laboratory equipment prior to handover for maintenance to ensure that the maintenance work can be carried out safely by a person(s) other than Technical Staff;
- monitor the serviceability of fixtures, portable equipment and apparatus and facilitate repair and/or replacement as required;
- ensure that all chemicals and hazardous substances are stored, labeled and used in accordance with legislation and advice contained in Safety Data Sheets (SDS);
- ensure all laboratory safety equipment (fixed and portable) is properly installed and remains in a serviceable condition;
- ensure SDS are current, legible, readily available and retained appropriately;
- remain abreast of any legislative or industry changes that may materially affect health and safety management within a laboratory setting;

- all incidents, hazards and 'near miss' incidents are reported using the SCU Incident, Accident & Hazard Report Form and notified to the Technical or Laboratory Manager and Head of Work Unit;
- prominently display and maintain emergency management information in each laboratory including the telephone numbers of:
  - Fire brigade;
  - Ambulance
  - Campus Security;
  - Hospital;
  - Police.

3.9 Facilities Management and Services Staff

Facilities Management and Services staff responsible for overseeing, coordinating, facilitating or delegating contractual work relating to the (re)design, modification, repair and/or upkeep of a laboratory or facilities are required to ensure that:

- the relevant Technical or Laboratory Manager(s) and/or Technical Staff are fully appraised of any work prior to commencement;
- the principal contractor(s) who may be responsible for the work strictly adhere to the requirements of the *WHS ACT 2011* and the WHS Regulations 2011 and ensure that their sub contractors are competent, hold the appropriate licences, certificates of competency, permits and accreditations and undertake the work in a safe manner;
- any sub contractors engaged by the University are competent, hold the appropriate licences, certificates of competency, permits and accreditations and have prepared appropriate risk assessments and work method statements, have attended a SCU WHS induction training program prior to commencing work and understand the nature of the working environment.

3.10 Undergraduate Students

Undergraduate Students' practicums represent a major proportion of the work undertaken in Laboratories. It is essential therefore that Undergraduate Students:

- are fully conversant with these Guidelines, any safety procedures that apply to their practical work in particular and the laboratory in general;
- understand the risk assessments that are relevant to their practical work and are able to implement the risk control measures that are acceptable to the University;
- adhere to the safe work practices at all times;
- have completed appropriate Laboratory Safety inductions prior to commencing laboratory work;
- adhere to acceptable housekeeping standards;
- correctly use any safety equipment provided;
- understand that unsatisfactory behaviour will be dealt with as a disciplinary matter;
- report all accidents to the academic or casual academic responsible for their practicum so that an appropriate investigation can be carried out.

3.11 Honours and Postgraduate Students

Honours and Postgraduate students who conduct their research work in SCU laboratories and associated facilities are required to ensure that they:

- are fully conversant with these Guidelines and any safety procedures that apply to their research work in particular and the laboratory in general;
- carry out formal risk assessments in conjunction with their research supervisor prior to commencing work in a laboratory or associated facility;
- understand the risk assessments that are relevant to their research work and are able to implement the risk control measures that are acceptable to the University;

- do not undertake any new research work in a laboratory or associated facility that is not included in a current risk assessment, without consultation with their supervisor and completion of a formal risk assessment;
- adhere to the safe work practices at all times;
- have completed appropriate Laboratory Safety induction training prior to commencing their research work;
- undertake all necessary training and instruction relevant to their work;
- adhere to acceptable housekeeping standards;
- correctly use and maintain any safety equipment provided;
- understand that unsatisfactory behaviour will be dealt with as a disciplinary matter;
- immediately report all accidents, incidents, hazards and 'near miss' incidents to their research supervisor and the technical manager to ensure a proper investigation is conducted, and complete a SCU Incident, Accident & Hazard Report Form with supervisor and/or technical manager.

3.12 Contractors

Contractors are required to:

- strictly adhere to any conditions or requirements imposed by the University in contracts, agreements, scopes of work, specifications, variations, permits to work, risk assessments, work method statements or that may be part of any workplace induction program, orientation, inspection, handover or be required under legislation;
- comply with any reasonable direction given by Laboratory Staff in the interests of health, safety and welfare;
- immediately report any incident or accident or any unexpected occurrence to Laboratory Staff.

3.13 Visitors

All visitors are required to comply with any reasonable directions that may be given by laboratory staff in the interests of promoting and maintaining health, safety and wellbeing within laboratories and facilities.

A visitor is any person who is not permanently authorised by the University to work or learn in the laboratory or facility concerned and who has not received appropriate laboratory induction training.

Visitors may include but not necessarily be limited to other SCU staff, visiting academics, students, clients, contractors and members of the public.

3.14 References

WHS Act 2011
WHS Regulation 2011
SCU Incident, Accident & Hazard Report Form
SCU Code of Conduct
Australian Code of Conduct for the Responsible Conduct of Research

4 Security Management

4.1 Introduction

Many substances, equipment and materials contained in a laboratory require specific hazard control measures to ensure that individuals and the community are not exposed to unreasonable levels of risk.

Laboratory security plays an important role in ensuring that unauthorised persons cannot readily access hazardous equipment, materials and substances.

Security must be maintained within all laboratories at SCU at all times to ensure that the University's laboratories are not readily accessible to unauthorised persons.

4.2 Key Aspects of Security Management

At SCU effective laboratory security measures should focus on the following key areas:

- people;
- buildings; and
- contents of buildings.

4.2.1 People

People security means that only authorised people should be permitted to enter and/or remain in a laboratory and/or associated facilities.

Any member of staff who has reason to believe that there is an unauthorised person in a laboratory and/or associated facilities should immediately inform the Technical or Laboratory Manager and contact Security Staff.

All staff should carry an appropriate identification card and actively monitor the overall security status of the laboratory and/or associated facilities.

Any person who has been provided with a pin code, card, pass key, lock combination or otherwise granted access to a laboratory and/or associated facilities by the University MUST NOT, under any circumstances, share their means of access with a third party.

People who are behaving in a manner that could compromise security or safety within a laboratory and/or associated facilities should be requested to leave. In the event of the person refusing to leave Security Staff should be contacted immediately.

Access by contractors to a laboratory and/or associated facilities is conditional upon the contractor following all the security requirements relating to the laboratory and/or associated facilities.

Contractors who provide routine cleaning and maintenance services must complete the 'Contractor Induction Training' course coordinated through Facilities prior to commencing work in a laboratory and/or associated facilities.

Access should be limited to times when trained laboratory staff are present.

4.2.2 Buildings

Building design and construction is critical to maintaining the security of a laboratory and its contents.

In some cases buildings have alarms installed to alert security staff that an unauthorised entry has occurred or an event requires a particular emergency response e.g. a fire alarm has been activated.

Staff must familiarize themselves with all alarm systems within the laboratory to ensure that they can respond effectively and without delay.

The windows and doors of all laboratories must be kept locked and secure at all times when the laboratory is not occupied.

Swipe card readers, automatic door closers, self-locking doors and other forms of building security equipment must be maintained to a serviceable operating standard. Staff are required to report any unserviceable or malfunctioning equipment to the Technical or Laboratory Manager or Facilities for rectification.

Under no circumstances should security, fire or self-locking doors be chocked open.

4.2.3 Contents of Buildings

As discussed earlier laboratories contain a range of 'at higher risk' substances, materials and equipment that require different levels of secure storage.

Particular area(s) of a laboratory e.g. store rooms, flammable liquid cabinets, cool rooms, fridges, freezers, steel cages, have been designed, constructed and installed to improve security of these substances, materials and equipment. The storage facilities should therefore be kept locked at all times when not in use.

Staff must also ensure that 'at higher risk' substances, materials and equipment are handled and stored correctly at all times so that the risk of injury to persons and/or theft from a laboratory is reduced to a minimum.

An up-to-date inventory of all 'at higher risk' substances (the University has the Online Chemical Inventory Database [OCID] for this purpose), materials and equipment should be kept, maintained and regularly audited by staff in control of these items, to ensure they are fully accounted for, safe, secure and not accessible to unauthorised persons.

Only the minimum quantities of 'at higher risk' substances, materials and equipment should be left in the general work area of the laboratory for the period of time required to achieve the desired learning outcome(s).

4.3 Reporting Breaches of Security

All breaches of laboratory security (including suspected breaches) should be reported to the University's Campus Services Supervisor and the relevant Head of Work Unit, via the Technical or Laboratory Manager.

5 Emergency Management

5.1 Introduction

Emergency management is a critical aspect of people and property safety at SCU.

The University has developed a comprehensive Emergency Procedures Plan and Crisis Management Plan, the implementation of which is overseen by a Crisis Response Team (CRT).

The CRT is the principal advisor to the Vice-Chancellor on all matters relating to Crisis Response at the University.

The aim of the Emergency Procedures Plan is to enable management and staff to quickly and decisively respond to any emergency, which could:

- threaten the safety of persons, property or the environment;
- interrupt or significantly diminish the capability of the University to undertake its usual business operations.

Whereas ultimate and overall responsibility for emergency planning lies with the Vice Chancellor, at SCU all line managers are accountable to the Vice Chancellor for ensuring that:

- emergency management plans that best suit the particular emergencies that are likely to arise in a given work area, are developed and implemented in the workplaces under their control, having regard to the nature and extent of the hazards and processes present therein;
- emergency controllers and wardens receive the necessary training and information to enable them to discharge their duties effectively;
- emergency management plans are regularly tested, reviewed and modified.

5.2 Responsibility for Developing, Implementing & Testing of Plans

Technical Managers are responsible for ensuring that measures are taken to assess the nature and extent of the risks posed by the hazards and processes carried out in their laboratory and ensure that an effective emergency management plan is developed and implemented.

Technical Managers must ensure that the laboratory emergency management plan is compatible with the University's overall emergency procedures plan.

5.3 Staff Involvement in Implementing Emergency Management Plans

All laboratory staff are required to be familiar with and take an active role in the implementation of the laboratory emergency management plan should the need arise.

Key laboratory staff e.g. emergency wardens, first aid officers and academics in charge may be required to carry out a critical role in an emergency to ensure that an emergency response is timely, appropriate and effective.

It is particularly important for these key staff to be identified and receive training as part of the emergency planning process.

5.4 Testing of Laboratory Emergency Management Plans

The Technical or Laboratory Manager is responsible for ensuring that emergency management plans are tested on a regular basis. The primary purpose of the testing is to ensure that:

- SCU staff responsible for initiating emergency management systems, utilising emergency equipment and coordinating the emergency response can respond confidently and effectively so that people and property are not exposed to unnecessary risk;

- laboratory emergency management plans and systems are compatible with the response provided by Security Staff and other essential services e.g. fire, ambulance;
- the University's laboratory emergency management plans and systems are regularly reviewed and modified if required.

5.5 Emergency Contact Numbers

Relevant emergency contact numbers need to be displayed in prominent locations or provided to workers (e.g. on an emergency response card).

External Emergency Services ('**0 000'**) - If an emergency is life threatening or there is imminent risk to either property or the environment, first dial '**0**' to obtain an outside line, then dial '**000**' to be connected to emergency services (Fire, Police or Ambulance). Then contact Security on **3333** to inform them of the emergency situation.

5.6 Dangerous Goods Emergencies

Dangerous goods emergencies usually involve the spill, leakage or escape of a dangerous good(s) thereby creating additional risk for persons in the immediate area and/or emergency management teams.

All workplaces must make arrangements for emergencies, regardless of the quantities of dangerous goods.

Emergency procedures should be developed on the basis of the needs indicated by the risk assessment (see also Section 5.8 Spills Management). This would include an assessment of:

- the nature and quantity of the dangerous goods stored or handled;
- the types and likelihood of emergencies;
- the fire protection and other emergency equipment provided;
- the physical features of the premises;
- access to the premises by emergency services;
- the number of people likely to be on the premises or adjoining premises.

Specific management information (e.g. drain covers and absorbent materials) for the containment of the emergency may need to be provided. It is the responsibility of the Technical or laboratory Manager in consultation with other staff to ensure that such information and material is readily available, prominently displayed and properly maintained.

The Australian Standards Handbook HB 76-2004 *'Dangerous Goods – Initial Emergency Response Guide'* recommends a six-step approach for dangerous goods incidents:

- Raise the alarm;
- Secure the area;
- Approach with care;
- Identify products;
- Assess the situation; and
- Respond accordingly.

To manage dangerous goods emergencies effectively the 'first responder' should consider the following points when at an accident site involving dangerous goods:

- always advise someone else of the emergency before attempting to control the situation;
- identify the hazards and products involved from storage containers, DG class labels or placards in the area. Seek additional help from SDS and other available documents (e.g. inventories, SOPs);

- assess the situation using available information and documents. Knowing the physical and chemical properties of the product will determine the appropriate response and evacuation procedures;
- remember that many harmful chemicals are colourless and/or odourless, including gases, which are also heavier than air and accumulate in low lying areas;
- minimise exposure to the hazards by wearing the appropriate PPE and avoiding inhalation of gases, fumes and smoke. Work upwind if emergency is in a ventilated or outdoor area;
- if you cannot determine the nature of the material and its hazards, secure the area and contact emergency services;
- decontaminate equipment, clothing and persons, including any victims, on site if safe to do so;
- safely dispose of contaminated materials or seek specialist advice on disposal from the manufacturer or the local government authority (EPA);
- if human exposure has occurred seek medical assistance immediately and provide full details of exposure;
- all incidents, hazards and 'near miss' incidents involving dangerous goods must be reported to laboratory staff and a SCU Incident, Accident & Hazard Report Form must be completed. A copy should also be sent to the Head of Work.

5.7 Needle-Stick Injuries and Other Biological Hazard Exposures

5.7.1 Introduction

Laboratories may contain a number of biological hazards that have the potential to cause harm. These include specimens of human origin (e.g. blood, blood products, body fluids) and/or potentially infectious and/or hazardous agents such as animal blood or tissues, and contaminated sharps.

Technical or Laboratory Managers in consultation with Technical Staff should develop specific protocols to manage injuries that result from an exposure to a biological hazard.

5.7.2 Management of Needle Stick & Biological Exposures

The following information is provided to assist Technical Managers and Technical Staff formulate effective biological hazard exposure protocols.

The procedures from the SCU Blood Borne Pathogens Policy should be implemented when there has been, or there is reason to believe there has been, an inappropriate exposure to a biological hazard such as a needle-stick injury or a cut, or a mucous membrane exposure to human blood or other body fluids.

All needle stick and biological exposure incidents must be reported by completing a SCU Incident, Accident & Hazard Report Form. A copy should also be sent to the Head of Work Unit.

Refer also to *NOHSC:2010 (2003)* and to *NSW Department of Health Infection Control Policy*

5.8 Spills Management

5.8.1 General Requirements

Spills in the laboratory may range from a minor incident to a significant hazardous event that may result in a person(s) and/or the environment being harmed.

Spills emergency plans must be developed and personnel trained in how to implement the plan(s) and any specific procedures that must be followed.

Safety Data Sheets must be readily accessible for all chemicals used in the laboratory. Information regarding how to manage spills should be read and understood by all who work or learn in a laboratory.

The method(s) and material(s) used for spill containment will be dependent upon a number of key factors. These include but may not be limited to the:

- toxicity of the substance;
- nature and type of substance;
- size of the spill;
- location of the spill;
- consequences of the spill;
- compatibility with other goods that could be spilt; and
- ready availability or otherwise of emergency services

5.8.2 Emergency Spill Procedure

If a spill occurs the following procedure should be followed:

- implement immediate measures to minimise exposure of persons (including own self) to the material that has been spilt by evacuating the immediate area or the laboratory;
- ensure that a person(s) is posted at the entrance(s) to the laboratory to stop unauthorised people from entering the contaminated area;
- alert Technical or Laboratory Manager to the emergency situation as soon as possible;
- do not attempt to clean-up the spill unless effective risk control measures can be implemented e.g. the nature of the material is known, the correct method of clean up is understood and personal protective equipment is available;
- determine if the spill can be managed at the local level using information on the nature of the material, the extent of the spill, and the resources available to contain and/or treat the spill;
- if the emergency management information contained in the Safety Data Sheet (SDS) is unclear or the SDS cannot be accessed for any reason, contact emergency services;
- ensure that all absorbent or contaminated material is placed in sealed containers, labelled and appropriately disposed of as contaminated waste at the completion of the clean-up; and
- all incidents involving major spills must be reported to laboratory staff and a SCU Incident, Accident and Hazard Report Form must be completed.

5.8.3 Maintenance and Supply of Spill Kits

All laboratories should have kits that are appropriate for controlling the risks associated with a spill of the type of hazardous material(s) being used.

Technical staff are responsible for ensuring that all spill kits are appropriately located, maintained and are readily accessible at all times.

Commercially available kits may be purchased for specific hazards, or may be prepared after referring to Safety Data Sheets. Kits should be placed in the appropriate area(s) before the hazardous material(s) is used and may include:

- suitable personal protective equipment (including clothing, chemically resistant gloves and boots, safety glasses/face shields, respiratory equipment);
- material to contain the spill (e.g. clean, dry sand or a commercial product);
- material to absorb the spill (e.g. clean, dry sand or vermiculite, absorbent towels or a commercial product);
- warning placards and barriers (e.g. Do Not Enter, Biohazard);
- approved containers to contain leaking packages and store waste materials;

- materials for decontamination procedures (e.g. sodium hypochlorite, ethanol, iodophore);
- neutralising agents (e.g. soda ash);
- hand tools such as mops, buckets, squeegees and bins; and
- portable ventilation equipment.

5.8.4 Chemical Spills

Chemical spills may be converted to a less harmful form by neutralization, oxidation or reduction. When decontaminating spills, care must be taken to ensure that the spill and/or resultant product:

- does not contaminate the environment;
- does not enter the sewerage or drainage system; and
- is disposed of appropriately.

In the event that decontamination is not an option and/or the spill is too large and/or you are not trained in chemical spills management, the first priority then is to follow the emergency spill procedure and report the incident immediately to the Laboratory Manager.

Neutralization decontamination procedures may be used for spills of acids and bases. The following criteria must be taken into account when determining the procedure to be used:

- the identity and concentration of the acid or base;
- the possible violence of the neutralization reaction;
- the surface material to be decontaminated; and
- the quantity of the spill.

To neutralize a spill:

- contain the spill by surrounding it with a non-combustible material e.g. sand;
- neutralize acid spills with lime, soda ash, calcium carbonate, sodium bicarbonate or limestone;
- use only dry products with acid spills as water reacts violently with concentrated acids;
- neutralize alkali spills with a dilute solution of hydrochloric or acetic acid;
- after the neutralization reaction is complete, collect the end-product by absorbing with a non-combustible material and then scoop up the material; and
- seal material in an appropriate container prior to disposal.

Qualified and expert professionals should handle concentrated spills of greater than 1 litre. In cases when the spill exceeds or is suspected to exceed 1 litre the contaminated area/facility should be evacuated and when deemed necessary, emergency services contacted.

Oxidation decontamination may be used to treat spills of aqueous cyanides, phenols and other organic substances. This type of decontamination procedure should not be undertaken by laboratory staff for large spills (greater than 1 litre) as the reaction may generate excessive amounts of heat and toxic products and therefore be difficult to control. Expert assistance should be sought to deal with such spills.

Reduction decontamination may be used to treat spills of heavy metal solutions (e.g. lead or mercury). These reactions may also be difficult to control and generate large amounts of heat and toxic products. As a result, laboratory staff should not perform such procedures in response to large spills (greater than 1 litre), but rather seek expert assistance from emergency services.

For other chemical substances refer to the SDS for specific spill procedures or seek advice from the Technical Manager/Supervisor.

Chemical Spills in Fume Cupboards

The basic steps for chemical spills in fume cupboards are:

- use **standard operating procedures** for chemical spills e.g. use appropriate personal protective equipment etc;
- always leave the fume cupboard exhaust running while cleaning up spills;
- small liquid chemical spills should be contained and absorbed with absorbent towel, pads or mats. Leave the absorbent material in the fume cupboard to allow fumes to extract before disposing appropriately;
- solid spills should be cleaned by wet mopping or using vacuum cleaning;
- refer to chemical SDS for detailed spills management information;
- in the event of a fire or large liquid chemical spill, ***immediately activate the emergency isolator button***, to isolate all electrical or gas services, and leave the exhaust running. Allow sufficient time for fumes to extract before cleaning up the spill; and
- refer to the manufacturer's manual for directions on how to clean and decontaminate the work surface and the sump area under the fume cupboard work platform.

See also Section 18.2 Fume Cupboards.

5.8.5 Mercury Spills

All laboratory areas using mercury or mercury filled equipment should ensure that appropriate spill kits are readily accessible, and personnel have been trained in the proper procedure to follow in the event of a mercury spill. Commercial mercury clean up kits are available for purchase and should be seriously considered in laboratories where mercury is used.

After a mercury spill, the immediate area should be isolated and the clean-up procedure commenced. Consider evacuating the area if a large area of the laboratory and/or its equipment has been contaminated, or if ventilation is inadequate.

All personnel involved in the clean-up should use the appropriate personal protective equipment e.g. impervious disposable gloves (PVC or rubber). A mercury vapour respirator should be used for large spills.

If the spill is of only a few droplets, the mercury may be picked up on wet toweling, adhesive tape, or by pasteur pipette or vacuum pump.

More significant spills should first involve collecting the large droplets, using a scraper or piece of cardboard. The resulting pool should be collected using a special vacuum pump or an industrial vacuum cleaner fitted with a charcoal filter trap.

Large spills should be handled by experts as decontamination of work surfaces and environmental monitoring may also be required.
Metallic mercury waste should be placed in an approved container, labelled and disposed of appropriately.

Always refer to the supplier's SDS for specific procedures for handling spills.

5.8.6 Radiation Spills

Refer to the Radiation Safety Manual.

5.8.7 Biological Spills

5.8.7.1 Introduction

Biological spills are spills that contain potentially pathogenic microorganisms and/or other biohazardous materials such as specimens of human origin (e.g. blood, tissues), and/or other potentially infectious or hazardous biological material (e.g. animal blood or tissues).

As with all laboratory spills biological spills must be dealt with immediately to minimise the risk of infection and contamination.

The basic steps for biological spills management are:

- use **standard operating procedures** for biological spills e.g. use appropriate personal protective equipment etc;
- confine and contain the spill;
- do not exacerbate the risks by generating aerosols during the clean up;
- do not use an aerosol disinfectant to decontaminate the spill;

If the spill involves specimens of human origin and/or other potentially infectious or hazardous biological material then follow the SCU Blood Borne Pathogens Policy.

Biological spills may be decontaminated with one of the following liquid disinfectants:

Sodium hypochlorite

- treat areas that are heavily soiled with microorganisms, blood or body fluids with a 0.5 – 1.0% solution for at least 10 minutes;
- contaminated (but not visibly soiled) work surfaces treat with a 0.05% solution for at least 10 minutes. General work surfaces may also be routinely cleaned with 0.05% solution;
- wads of absorbent paper towel or cotton wool soaked in 0.5% hypochlorite solution may be used to absorb and/or wipe down the area affected by the spill. Contaminated materials should be discarded by placing the materials into an approved container for decontamination and disposal. Wipe the area with hypochlorite solution again, if necessary, and give the area a final rinse with water and detergent;
- hypochlorite solutions may be corrosive to metal objects. Use 70% ethanol or iodophore solutions on metal surfaces; and
- a fresh supply of working solutions should be prepared daily.

70% Ethanol (v/v in water)

- must be in contact with material being disinfected for at least 20 minutes; and
- industrial methylated spirit (95% ethanol) appropriately diluted is an acceptable alternative.

Iodophore Solution (0.5% Iodine in 70% (v/v) Ethanol)

- must be in contact with material being disinfected for at least 20 min; and
- always follow manufacturer's recommendations to give at least 100 mg available iodine per litre.

For further information refer to *NOHSC:2010 (2003)* and to *NSW Department of Health Infection Control Policy*

5.8.7.2 Microorganisms

The following risk criteria must be considered when treating a spill:

- the risk level of the microorganism, see Section 14.3.2 Risk Groups;
- the amount and concentration of the spill; and
- whether the spill has occurred within containment equipment (e.g. biosafety cabinet) or has breached the confines of the containment equipment.

Small spills of low-risk microorganisms should be treated as follows:

- cover the spill with paper towel soaked with a suitable disinfectant (refer to *AS/NZS 2243.3*) then allow at least 10 minutes for the disinfection to occur;
- wipe surrounding surfaces with disinfectant;
- carefully mop up the spill with dry towels and place all contaminated material into appropriate receptacles for disposal. Do not autoclave any materials soaked with hypochlorite solution as there is a risk a toxic gas may be produced; and
- at completion of spill clean-up, remove PPE and wash hands thoroughly.

High-risk spills of greater than 10 mL occurring outside containment equipment should be treated as follows:

- avoid breathing the aerosols and immediately vacate the laboratory;
- shut laboratory doors and place appropriate warning signs around the area (e.g. Do Not Enter, Biohazard)
- remove all contaminated clothing and place in a biohazard bag for decontamination;
- wash affected areas (shower if necessary) and put on clean PPE;
- notify the appropriate supervisor of the area so that an appropriate clean-up team can be assembled to deal with the spill;
- do not enter the area for at least 30 minutes to allow aerosols to settle;
- isolate the ventilation system if necessary;
- pour an appropriate amount of disinfectant (e.g. hypochlorite solution) around the spill and allow it to mix slowly. This will prevent generation of further aerosols;
- saturate paper or cloth towels with disinfectant and place them gently over the spill. Allow 30 minutes for disinfection to occur;
- wipe surrounding surfaces with disinfectant;
- carefully absorb the spill with dry towels and place all contaminated material into approved receptacles for disposal. Do not autoclave any materials soaked with hypochlorite solution as there is a risk a toxic gas may be produced;
- remove and appropriately decontaminate PPE;
- report incident to laboratory staff and complete a SCU Incident, Accident & Hazard Report Form. A copy should also be sent to the Head of Work Unit.

5.8.7.3 Spills in Biosafety Cabinets

Biological spills in biosafety cabinets of up to 1 mL should be treated by flooding the cabinet with a suitable disinfectant solution. The solution should be mopped up with a suitable absorbent material then placed in an approved container for decontamination and/or disposal.

Larger spills in biosafety cabinets are not considered as hazardous as those outside the cabinet because they are contained. The following procedure should be commenced immediately:

- ensure that the cabinet remains turned on;
- place absorbent material soaked in a suitable disinfectant over the spill (refer to *AS/NZS 2243.3*). Allow at least 10 minutes for disinfection to occur;
- after spill clean-up, disinfect gloved hands and remove gloves in the cabinet. Remove all contaminated clothing and place in a biohazard bag for decontamination;
- wash hands and arms and put on clean PPE;
- decontaminate adjacent surfaces, materials and equipment and appropriately discard any material associated with the spill;
- wipe down the work area and front grille of the cabinet with fresh disinfectant;
- check that the sump has not been contaminated. If contamination has occurred, add enough disinfectant to completely cover the sump floor;

- if further decontamination of the cabinet is necessary, contact the relevant laboratory Technical Manager who will arrange for formaldehyde gas decontamination by an approved contractor;
- complete a SCU Incident, Accident & Hazard Report Form.

5.8.7.4 Human Blood and Body Fluids

Spills of other biohazardous material (such as specimens of human blood, body fluids or tissue that may contain HIV or hepatitis virus, and other potentially infectious and/or hazardous agents) must be dealt with immediately so as to minimise the risk of infection to other persons.

All persons handling biohazardous material must receive instruction and training in the safe handling, storage, transport and disposal of such material, as well as any emergency management procedures. This instruction and training must be site specific and conducted by the Technical Manager or the person responsible for the biohazardous material.

The aims of biohazardous spills management are to:

- apply standard precautions, including use of appropriate PPE;
- confine and contain the spill;
- clear up spills before the area is cleaned or disinfected (adding cleaning liquids or disinfectants to spills increases the size of the spill); and
- avoid generation of aerosols from spilled material during clean up.

If a spill of biohazardous material has occurred outside a biological safety cabinet the following procedure should be followed:

- confine the area and assess the degree of the spill and subsequent potential contamination;
- ensure that appropriate PPE is available and used;
- for **small** spills (i.e. spots or drops of blood, or spills less than 10cm diameter), absorb with paper towel or other absorbent material, clean with warm water and detergent, and disinfect the area with an appropriate liquid disinfectant;
- for **large** spills (i.e. greater than 10cm diameter) minimise the potential of inhaling the aerosol, vacate the laboratory, shut the laboratory door and place appropriate signs to warn other people of the hazard;
- remove any contaminated clothing (including laboratory coat and gloves) and place them in a contaminated waste bag;
- wash face and hands and put on clean PPE;
- notify the Technical Manager of the incident so that a designated clean up team can be formed if necessary;
- cover the spill with enough dry material to absorb the spill. Appropriate material includes absorbent paper towel, clean dry sand, commercial pads or absorbents. The material must be compatible with the substance to be absorbed;
- place all material used in the clean up into impermeable plastic waste bags and dispose of as contaminated waste;
- clean the contaminated area with warm water and neutral detergent;
- spill area can now be disinfected with an appropriate liquid disinfectant (in most cases 0.5 - 1.0% fresh sodium hypochlorite is suitable). This can be done by gently placing paper towels or other absorbent towels that have been saturated with disinfectant straight onto the spill area. Allow the recommended time for the disinfectant to take effect, wipe over and allow to dry;
- wipe over, with disinfectant, any other adjoining surfaces that may have become contaminated by splashing;
- ensure that the affected area is left clean and dry;
- remove and autoclave protective clothing worn during the clean-up;

- do not autoclave any materials that have been soaked with hypochlorite solution due to the risk of toxic gas being produced;
- ensure that spill kits are adequately restocked after each use;
- The incident should be reported and documented. Complete a SCU Accident, Incident & Hazard Report Form. A copy should also be sent to the Head of Work Unit.

It is advisable that a spill kit be prepared or purchased and be readily available in the laboratory area. The spill kit can be housed in a large re-usable plastic bucket or container (10 L), and contain materials such as:

- impermeable plastic waste bags;
- absorbent pads, towels or granular disinfectant (containing 10,000 ppm available chlorine or equivalent);
- disposable lab coats;
- disposable resistant gloves;
- safety glasses or full face shield;
- disposable scraper and pan; and
- a respiratory protective device to protect against inhalation if dealing with a high risk spill.

Replace all disposable items after each use of the kit.

For further information refer to SCU Blood Borne Pathogens Policy *and* *NOHSC:2010 (2003)* and to *NSW Department of Health Infection Control Policy*

5.8.7.5 Spills in Centrifuges

The efficacy of spill procedures should reflect the risk group of the microorganism, see Section 14.3.2 or biohazardous material and the type of equipment involved.

- centrifuges with sealed rotors or autoclavable buckets may be steam sterilised at 121°C for an appropriate time;
- centrifuges with non-sealed rotors or non-autoclavable centrifuges:
    - allow 30 minutes for aerosols to settle;
    - put on appropriate PPE;
    - put rotor or bucket in a suitable non-corrosive disinfectant solution (refer to *AS/NZS 2243.3*);
    - remove broken glass or other material with forceps and discard appropriately;
    - wipe internal surfaces with disinfectant;
    - discard contaminated PPE appropriately and wash hands thoroughly; and
    - report incident to laboratory staff and complete a SCU Incident, Accident & Hazard Report Form. A copy should also be sent to the Head of Work Unit.

5.9 References

NOHSC:2010 (2003): National Code of Practice for the Control of Work-related Exposure to Hepatitis and HIV (Blood-borne) Viruses
NSW Department of Health Infection Control Policy (2005)
AS/NZS 2243.3:2002: Microbiological Aspects and Containment Facilities
SCU Incident, Accident & Hazard Report Form
SCU Blood Borne Pathogens Policy
SCU emergency contact numbers
SCU Emergency Procedures

6 First Aid

Senior Managers, Line Managers, Technical Managers, nominated First Aid Officers and persons in charge of field trips should be familiar with their responsibilities for providing first aid services, equipment and facilities as outlined in the SCU First Aid Policy.

7 Safety Equipment

7.1 Introduction

All laboratories are required to have safety equipment installed and/or available to manage the residual risk(s) that cannot be entirely eliminated by:

- effective building design and construction measures;
- limiting the use of hazardous substances or work practices; and
- implementing fixed guarding or other engineered hazard containment measures.

Safety equipment falls into three key categories i.e. fixed, portable and personal protective equipment (PPE).

7.2 Fixed Safety Equipment

The number, location and type(s) of fixed equipment will be determined by Facilities Management & Services in consultation with Technical or Laboratory Managers and Technical Staff having regard to relevant Australian Standards, building codes and best industry practice.

Fixed safety equipment can include but may not be limited to:

- safety showers with/without eye wash facilities (for further information see *AS/NZS 2982.1*);
- bench mounted fume extraction systems;
- fume cupboards, see Section 18.2 Fume Cupboards;
- drainage pits; and
- approved storage cabinets.

7.2.1 Safety Showers and Eyewash Facilities

Safety showers with/without eye wash stations must be made available in all laboratory areas where there is a risk of personal contamination. Access to safety showers should be unobstructed and within 10 metres of the work area.

Where eyewash facilities are not incorporated in a safety shower, they should be provided separately and in accordance with *AS/NZS 2982.1.* In older laboratories that have not been built to comply with *AS/NZS 2982.1*, single use packs of sterile eye irrigation fluids should be provided rather than refillable eyewash bottles, because of the danger of growth of microorganisms in multiple use eye irrigation fluids.

For specifications and installation requirements refer to *AS/NZS 2982.1* and *AS/NZS358.1.*

7.3 Fire Extinguishers, Fire Blankets and Fire Hoses

7.3.1 Introduction

Fire extinguishers, fire blankets and fire hose reels can be regarded as a type of emergency equipment.

In the case of fire the use of fire extinguishers, blankets and hose reels should not be preferred ahead of an effective building evacuation. **Only use fire-fighting equipment if you have been trained in its use and feel comfortable doing so.**

Before using a fire extinguisher read the instructions to ensure that it is appropriate to the type of fire.

7.3.2 Servicing, Checking and Replacement

Fire extinguishers, fire blankets and fire hose reels are serviced, checked and replaced under a contract that is overseen by Facilities Services and Management.

Fire extinguishers that have been discharged, either partially or completely, should be reported to the Technical Manager so that a replacement can be arranged.

Under no circumstances is a used extinguisher to be returned to its wall mount.

7.3.3 Signage and Placards

All fire extinguishers and hose reels must be signed and placarded with correctly installed Australian Standards approved symbols.

Any signs and/or placards that are not clearly legible must be reported to the Technical Manager so that replacements can be arranged.

7.4 Portable Safety Equipment

The number, location and type(s) of portable emergency equipment will be determined based upon the particular hazards and risks that are associated with the work and/or learning activities undertaken.

Portable safety equipment can include but may not necessarily be limited to:

- sterile packs of eye irrigation fluids;
- first aid kits;
- spill kits;
- trolleys;
- approved storage containers and cabinets e.g. dangerous goods cabinets; and
- protective shields.

7.4.2 Personal Protective Equipment (PPE)

PPE is equipment required to be worn by all who work in, learn in, visit or are otherwise contracted to undertake work in a laboratory (see SCU Personal Protective Equipment Policy). Only PPE that complies with Australian Standards is to be worn in a laboratory under the control of the University (Refer to *AS/NZS 2243.1:2005*).

The type of PPE that must be worn will be determined by the nature of the work being conducted and the outcomes of the Laboratory Risk Assessment process (See Section 8: Risk Management).

At the very least, the following PPE **must** be worn at all times in the laboratory unless lesser requirements can be justified by a risk assessment:

- a properly fastened **laboratory coat** that protects the arms and body. Long-sleeved cotton or cotton/polyester laboratory coats or wrap-around gowns are recommended for general laboratory work (*AS/NZS 2243.1:2005* clause 4.2.2);
- an appropriate disposable laboratory coat must be worn for all operations involving unscreened human blood and body fluids;
- non-slip, closed-in **shoes** that cover the toes, upper surface of the foot and the heel. Thongs, sandals, sling backs, shoes with open sections or bare feet are not permitted;
- Australian Standards approved **safety glasses**, goggles or eye protection appropriate to the type of work performed. Contact lenses or prescription glasses are not a suitable substitute for normal eye safety protection which should be worn in addition to these;

- appropriate **gloves** chosen to suit the particular application or work.

PPE shall be selected and used in accordance with Australian Standards as follows:

- coats (*AS/NZS 2243.1: 4.2.2*);
- eye and face protection (safety glasses, spectacles, goggles etc). (*AS/NZS 2243.1: 4.2.2* and *AS/NZS 1336, 1337* and *1338*);
- respiratory protection (masks, respirators, etc). (*AS/NZS 1715* and *1716*);
- gloves (*AS/NZS 2161*);
- hearing protection (*AS/NZS 1270*); and
- footwear (*AS/NZS 2210*).

7.4.3 Supply & Maintenance of PPE

Employers must provide employees with:

- the necessary Australian Standards approved PPE (free of charge) to undertake their work in a safe manner;
- training in the correct use of the equipment; and
- the means to maintain the equipment to a serviceable standard.

Employees are required to use the equipment appropriately and to take reasonable care and maintenance of the equipment during its working life.

The University can however, as a condition of learning in, or visiting a laboratory, and/or where a risk assessment specifically calls for PPE to be worn, require a student and/or visitor to obtain Australian Standards approved PPE at their own expense.

The University reserves its right to refuse any student(s) and/or other persons entry to a laboratory when the requisite PPE is not being worn.

Visiting a laboratory is conditional upon PPE being worn. The University may, in certain circumstances provide disposable PPE e.g. gloves, face-masks, earplugs.

All contractors are responsible for supplying and maintaining their own PPE. All contractors undertaking work in a laboratory must wear the requisite Australian Standards approved PPE.

7.5 References

AS/NZS 1270:2002 - Acoustics – Hearing protectors
AS/NZS 1336: 1997 - Recommended practices for occupational eye protection
AS/NZS 1337:1992 - Eye protectors for industrial applications
AS/NZS 1715:1994 - Selection, use and maintenance of respiratory protection devices
AS/NZS 1716:2003 - Respiratory protective devices
AS/NZS 2161:1-10 - Occupationally protective gloves (parts 1-10)
AS/NZS 2210:1&2:1994&2000 - Occupational Protective Footwear
AS/NZS 2243.1:2005 - Safety in laboratories – Planning and operational aspects
AS/NZS 2982.1:(1997) - Laboratory design and construction – General Requirements
ANSI Z358.1: Emergency eyewash and shower equipment (American Standard)
SCU Personal Protective Equipment Policy

8 Risk Management

8.1 Introduction

The *WHS Regulation 2011* imposes obligations on an employer to identify all foreseeable hazards that may arise from the conduct of the employer's undertaking, to assess the risks of those hazards and to eliminate the risks, but if not reasonably practicable to do so, to control the risks.

This should be taken to mean that when an occupational hazard has been identified, the employer's risk assessment process, in consultation with workers, must involve identifying what needs to be done to eliminate the risk in the first instance, or if this is not possible, deciding on appropriate control options to minimise the risk.

8.2 Laboratory Risk Assessment & Control Protocol

The University has developed a SCU WHS Risk Management Procedure that outlines the basic steps to be followed when conducting a risk assessment.

The responsibility for conducting risk assessments is detailed in Section 3 Responsibilities.

Laboratories are deemed by the University to be relatively high-risk areas due to the hazardous activities undertaken therein when compared to other work areas.

A Laboratory Safe Work Procedure (SWP) has therefore been developed so that a more rigorous and comprehensive risk assessment can be undertaken for all work that is undertaken in a laboratory.

Work in a laboratory includes but may not be limited to:

- lectures and/or tutorials;
- practical classes;
- research projects;
- experiments;
- training;
- demonstrations;
- erection, use and dismantling of apparatus;
- operating equipment;
- use of hazardous substances and dangerous goods; and
- changes to laboratory design, construction and/or layout.

The SWP consists of a SWP Checklist which identifies hazardous tasks and the measures to eliminate and control the risks in the work process. This protocol provides the flexibility needed to enable staff and students to select the relevant sections of the form that are most appropriate for the work, project or practical that will be assessed and encourages consultation between staff members.

Conventional occupational risk management theory demands that risk assessments be conducted at certain critical times. The list below sets out some widely recognised and accepted critical times for conducting a risk assessment:

- when a new hazard, hazardous situation or hazardous process has been identified;
- before an experiment is to be modified or changed, or conducted in a new area, or if there is a different or unexpected outcome;
- when a significant change is to made to a workplace, a procedure or a protocol;
- after a work related incident, accident or illness has occurred;
- when new plant or equipment is to be used or modifications are made relating to its design, construction or use; and

- when there is to be a change or a change is mooted to legislation or regulatory advice affecting the workplace or any activity conducted therein.

At SCU SWP relate directly to any work or learning activity that is to be undertaken in a laboratory or associated facility.

8.3 Safe Work Procedure (SWP) Templates

Generic Laboratory SWP Templates are available from the Workplace Health and Safety Team. Generally the SWP are completed by the Safety Support Officers (SSO) in consultation with Laboratory staff. SSO training is available for staff members, for further information please contact the Workplace Health and Safety Team.

8.4 Risk Assessments for Undergraduate Students

Undergraduate students should also be made aware of their risk management responsibilities when working in laboratory environments. This can form part of their laboratory practical experience, and can be facilitated through the use of a simple 'undergraduate safety checklist' that could be completed as part of their pre-laboratory work for each practical class.

The use of a simple safety checklist would allow undergraduates to quickly identify the major hazards and the risk control measures that have been put in place following the formal risk assessment process previously undertaken by the academic responsible for the practicum.

8.5 Risk Assessments for Hazardous Substances and Dangerous Goods

Refer to Section 13.4.

8.6 References

SCU WHS Risk Management Procedure

9 Laboratory Safety Inductions

9.1 Introduction

Any person entering a laboratory for the first time must undergo the appropriate laboratory safety induction training. The level and detail of the safety induction training should depend upon the work or activities to be undertaken whilst in the facilities.

Safety inductions and training for staff and students must be conducted before laboratory work can commence. It is the responsibility of the Work Unit to appoint the person responsible for conducting the safety induction.

The Work Unit must also establish and maintain a record of any person who has attended the training. Records must be kept for at least 5 years.

Sections 9.7 provide sample induction forms covering the information that should be covered as part of a typical laboratory safety induction program. The forms also have a section for declaration and sign-off that may be used for record keeping purposes.

9.2 Undergraduate Students

Undergraduate students must complete Laboratory Safety Inductions prior to commencing laboratory practicums. These should be specific to each laboratory area and include site specific emergency information.

The laboratory safety induction should be conducted by the academic responsible for the teaching of the laboratory practicums in conjunction with the technical manager or other laboratory staff who are in control of the laboratory(ies) where practicums are to be conducted.

9.3 Staff and Postgraduate Students

New staff and postgraduate students must complete appropriate site specific Laboratory Safety induction training prior to commencing their work or research.

The laboratory safety induction should be conducted by the supervisor or research supervisor in conjunction with the technical manager and designated laboratory staff in control of specific laboratory areas.

The 'Specific OHS Requirements Template' provides guidance for the core information that should be covered during a typical safety induction. This checklist may be modified to make it more applicable to individual laboratory areas.

9.4 Casual Staff

The requirements of these Guidelines apply in their entirety to any casual staff who may, for any period of time, be required to work in, visit or learn in any laboratory or associated facility to which these Guidelines apply.

9.5 Contractors Working Within Laboratories

Whereas contractors are required to undergo a general safety induction program prior to carrying out any work, ALL contractors who are required to work within a laboratory facility WILL require an additional laboratory specific safety induction.

Technical Managers in consultation with relevant stakeholders will determine the nature, timing, content and extent of the laboratory specific safety induction and ensure that such training is provided to the contractor before the contractor undertakes any work within the laboratory.

9.6 Visitors

Visitors and/or clients must report to the Technical Manager or relevant supervisor to undergo appropriate site-specific safety induction training prior to entering laboratory facilities.

Visitors and/or clients should be supervised at all times and must comply with all reasonable directions given to them by laboratory staff.

9.7 References

SCU Specific OHS Requirements Template

10 General Laboratory Safety

The laboratory is a potentially hazardous place to work. Strict adherence to laboratory safety rules and regulations can greatly reduce the risks associated with any potential hazards.

10.1 General Rules and Regulations

It is a condition of entry that all persons, whilst in a laboratory and/or any associated facilities, must understand the general laboratory safety rules and accept their responsibility under the OH&S legislation to adhere to the safety rules at all times.

Persons who act contrary to the Health and Safety Conduct on Campus may be asked to leave.

Individual Work Units should develop and implement local laboratory safety instructions that are designed to meet their specific needs but remain compatible with these rules. These local safety instructions should be communicated to all relevant persons and documented in local laboratory safety instructions and procedures.

10.2 Access to Laboratories and Associated Facilities

Laboratories usually operate between the normal working hours of 8:00 am to 6:00pm Monday to Friday. Evening undergraduate laboratory classes are considered to be within normal working hours for the teaching and any support staff involved.

Laboratories may also be opened for periods outside the normal working hours.

Any person who is granted permission to access laboratories outside the normal working hours must follow the 'Regulations for After Hours Work' (see below).

After hours work is defined as being work conducted in laboratories and associated facilities on:

Weekdays: 6.00pm – 8.00am
Weekends: Friday 6.00pm – Monday 8.00am

Work Units may also specify 'After Hours Work' policy in procedures or other directives. Staff and students should refer to their Work Units procedures or directives for any additional information, details and requirements with regard to 'After Hours Work'.

10.3 General Procedures for After Hours Work

- Workshops or laboratories will not be considered to be 'after hours' if they are under the control and supervision of authorised staff;
- Supervisors may give permission for access to buildings/laboratories outside normal working hours, provided that signing-in and out regulations are adhered to;
- It is recommended that at least two people be within close proximity when after hours work is being performed;
- When working after hours the security office at your campus should be notified of your presence, location and expected time of departure;
- Personnel working after hours should regularly check the well-being of co-workers in nearby laboratories (e.g. every 30 minutes); and
- See SCU Emergency Procedures in the event of an accident or emergency.

10.4 Working Alone or In Isolation

10.4.1 Introduction

At SCU people often work and/or learn alone. Working and/or learning alone should not be regarded as an inherently unsafe practice but rather as a practice that can be safely undertaken provided adequate risk control measures are implemented.

AS/NZS 2243.1 however identifies a number of high-risk hazards, and stipulates that a person not be exposed to such hazards while working alone or in isolation.

These hazards include but are not necessarily restricted to:

- "operating equipment or machinery, including workshop machinery capable of inflicting serious injury, such as chainsaws, firearms, lathes and power saws;
- handling venomous reptiles, insects, arthropods or fish;
- working with, or near, highly toxic or corrosive substances where there is a significant risk of exposure to the substance, taking into account the volume used
- working with large animals other than for feeding or observation;
- using apparatus that could result in explosion, implosion, or the release of high energy fragments or significant amounts of toxic or environmentally damaging hazardous material;
- climbing towers or high ladders;
- working with radionuclides requiring a high level laboratory in accordance with *AS/NZS 2243.1*;
- working with microorganisms of risk group 3 or higher, or those which require the use of Containment level 3 facility of higher in accordance with *AS/NZS 2243.3*;
- operating lasers of Class 3 and above;
- working with exposed energised electrical or electronic systems with powers exceeding 100 VA and voltages exceeding 40 V."

10.4.2 Risk Control

All working/learning alone situations should be the subject of a risk assessment and approval from Head of Work Unit before any work or learning activities commence. Key criteria that may be taken into consideration when conducting the risk assessment can include but not necessarily be limited to the:

- experience and training of the individual;
- nature and degree of hazard associated with the work;
- availability of control measures;
- effectiveness of the control measures;
- criticality of the work to be undertaken;
- likely harm that may result should an accident occur.

If work in isolation is permitted, then appropriate risk control measures should be incorporated into the local safe operating procedures e.g. emergency contacts, pagers, alarm triggers, work plans etc.

The table below identifies typical working alone situations with examples of appropriate risk control strategies for implementation.

Situation	Risk Control Strategy(ies)
work area is remote from other work areas e.g. a laboratory in another unoccupied building	• advise a work colleague or Security Staff of where you are and what you will be doing, and ask them to check on you every hour
work area is isolated from other work areas e.g. a laboratory that is specifically isolated and/or locked because of the classification of the laboratory	• advise a work colleague or Security Staff of where you are and what you will be doing and that you will phone every hour to report that you are ok
work to be carried out will not be completed until late at night necessitating a long walk in the dark to a motor vehicle	• park vehicle closer to place where work is to be carried out during daylight hours so the length of the walk is reduced • contact security staff and request an escort to vehicle at completion of work
work to be undertaken is relatively high- risk e.g. person is to perform a high-risk experiment using toxic substance	• organise for another person be available for the time that it takes to complete the experiment as opposed to the setting up time etc

10.5 Unattended Work In Progress

A 'Notice of Experimental Activity Card' must accompany experimental work in progress that is unattended for any length of time.

The card must provide information that is appropriate and relevant to the type of work in progress and (as a minimum) provide the following information:

- the nature of the work in progress;
- key safety and emergency information;
- an emergency contact number(s); and
- critical first aid information.

Shorthand information and abbreviations on work in progress cards is not acceptable.

The card must be prominently displayed in the immediate vicinity of where the work is being undertaken, and it remains the responsibility of the person undertaking the work to ensure that the card remains displayed at all times whilst the work is in progress.

10.6 Overnight Work In Progress

All experimental work involving potentially hazardous material, that is unattended between 6:00 pm and 8:00am, must be set up in an area that will render it safe and contain any potential spills (e.g. set up of a chemical reaction in a fume cupboard).

Security staff must also be advised that the work in progress will run overnight.

The person responsible for setting up the work in progress or work that runs overnight MUST ensure that a 'Notification of Experiment Activity Card' is completed and displayed as required (see above).

In addition any equipment and fume cupboards that are critical to the work and need to be left on after hours must carry a 'Please Leave On' notice with name and after-hours telephone number of the

person(s) responsible for undertaking the work so that they can be contacted in the event of an emergency.

10.7 Housekeeping

Cleanliness and tidiness is widely recognised as an essential and effective risk control measure within a laboratory environment.

The checklist below provides essential and practical information aimed at helping staff and students ensure that their work area is maintained in a clean and tidy condition.

SCU LABORATORY HOUSEKEEPING CHECKLIST

- keep your work area free from clutter and organise materials and equipment so as not to present a hazard;
- plan new work carefully and use the risk assessment process to consider necessary safety precautions or control measures that may be required prior to commencing work;
- tidy work area and clean-up work surfaces after each project or at the end of each day;
- clean up equipment after use to ensure it is kept in good working order;
- ensure that any chemicals, materials or equipment not in immediate use are properly stored;
- ensure that all laboratory wastes (e.g. chemical, biological, radioactive, sharps or mixed) are properly segregated and disposed of at point of use in accordance with Laboratory Waste Management Procedures;
- avoid the accumulation of paper waste as it provides a ready source of fuel for fire;
- clean up spills immediately and thoroughly using appropriate equipment, materials or spill kits. See also Spills Management Section 5.8.

10.8 Glassware (General)

Accident statistics indicate that broken glassware accounts for a significant proportion of injuries that occur in the laboratory.

The following guidelines apply to the handling and use of glassware:

- glass ware must be securely stored so as to minimise the risk of breakage;
- glass tubing should have the ends flame polished;
- do not use broken or chipped glassware;
- protective gloves should be worn when cleaning glassware;
- commercial agents may be used however chromic acid should only be used as a last resort;
- only non-contaminated broken glass can be placed in approved bins that are marked 'Broken Glass';
- glassware modification by glass blowing is not permitted; and
- eye protection should be worn when conducting procedures involving the manipulation of glass.

10.9 Handling and Disposal of Sharps

10.9.1 Introduction

Sharps can be classified as any object or device having corners, edges, points or protuberances that have the potential to cut or puncture the skin e.g. broken glass, scalpel blades, razor blades, hypodermic needles, intravenous sets, pasteur pipettes etc.

Sharps, like other laboratory wastes, should be segregated on the basis of the primary hazard they pose. In addition, if secondary hazards are present, then persons handling sharps and/or generating

sharps waste need to make an assessment as to whether further segregation is required in order to ensure that any secondary hazards associated with handling the waste are properly identified and controlled.

10.9.2 Broken Glass (Clean and Contaminated)

Broken glassware should be segregated into approved ***'Clean'*** or ***'Contaminated'*** broken glass containers. Persons handling the glassware are responsible for its segregation, decontamination (if required) and correct disposal at the time of generation.

Clean broken glass is laboratory glassware that is not contaminated with any biological or infectious material (human or animal blood, body fluids, parts or materials; microbiological materials), toxic, cytotoxic, recombinant or radioactive substances or chemicals.

- Clean broken glass may be collected into a dedicated rigid impenetrable container or bin that is clearly labelled with 'Clean Broken Glass'. When full, the container should be sealed to prevent injury to persons handling the container and be transferred to the nearest industrial waste bin for disposal;
- Where a glass recycling service exists, then the sealed container may be transferred to the recycling bin. Borosilicate glassware such as pyrex is not suitable for recycling;
- Fluorescent tubes should be placed directly into industrial waste bins;

Contaminated broken glass should be dealt with in the following manner:

- small items (e.g. beaker < 500 ml) should be placed in sharps containers for collection and disposal by an approved contaminated waste contractor;
- large items of broken glassware should be decontaminated before disposal;
- if contaminated with chemicals, safely extract fumes from glassware overnight in a fume cupboard and decontaminate appropriately before placing into a 'Clean Broken Glass' container for disposal into an industrial waste bin when full;
- if contaminated with biological products or infectious materials, items should be autoclaved or disinfected to remove any contamination before placing into a 'Clean Broken Glass' container for disposal into an industrial waste bin when full.

10.9.3 Handling and Disposal of Other Sharps

For sharps other than broken glass:

- all sharps must be handled with care as they present a high risk of injury;
- staff must be trained on how to deal with accidents/incidents involving sharps;
- students must be instructed on how to handle and dispose of sharps correctly;
- immediately after use, all sharps should be discarded into an approved 'sharps container' that conforms to AS 4031;
- needles should not be purposely bent or removed from syringes, or recapped after use;
- disposable needle/syringe sets should be discarded as a single unit;
- syringes and needles, even if 'clean', must be disposed directly into a sharps container to protect the community at large from misuse;
- sharps containers shall be located at the point of use and not overfilled;
- all general rubbish bins located in areas where sharps are used, should be labeled "Not for Sharps Disposal" and checked at the end of the day by trained laboratory staff for inappropriately discarded sharps;
- the person **using** the sharps is responsible for its proper disposal;
- where sharps are found, the person **finding** the sharps is responsible for its proper disposal;
- sharps containers shall be sealed and placed in a lockable contaminated waste bin prior to pick up by a licensed waste disposal contractor for incineration.

UNDER NO CIRCUMSTANCES SHOULD THE CONTENTS OF SHARPS CONTAINERS BE EMPTIED INTO GENERAL GARBAGE BINS OR INDUSTRIAL WASTE BINS, NOR BE EMPTIED and RE-USED.

10.9.4 Injury With Sharps Contaminated With Blood or Other Biological Material

Exposure to potentially harmful pathogens that may be found in blood, body fluids and other biological material is increased when needles, scalpels and other sharp instruments and devices are used.

Penetrating wounds break the normal protective barrier provided by the skin and can result in infection.

If a person suffers a needle stick or other sharps injury, or is exposed to blood or other body fluids during the course of their work or learning, the attached Emergency Action steps must be immediately followed. See Section 5.7.

10.10 References

AS/NZS 2243.1:2005 - Safety in laboratories – Planning and operational aspects
AS/NZS 2243.3:2002 - Safety in laboratories – Microbiological aspects and containment facilities
AS 4031:1992/Amdt 1-1996 - Non-reusable containers for the collection of sharp medical items used in health care areas
SCU Emergency Procedures
Health and Safety Conduct on Campus

11 Gas Cylinders

11.1 Introduction

SCU uses a range of products that are delivered in gas cylinders that are designed and constructed to meet Australian Standards.

All persons working with gas cylinders should familiarize themselves with *AS 4332* to obtain more information about the storage and handling of gases in cylinders.

11.2 General Precautions

The following general precautions shall be observed for minor storage and handling of gas cylinders:

- gas cylinders are to be kept away from artificial sources of heat, i.e. radiators, boilers or steam pipes, and unobstructed ;
- gas cylinders shall be provided with adequate ventilation at all times;
- classes of gas cylinders shall be segregated within the store, but need not be separated by physical barriers;
- outdoor storage of Class 2 cylinders shall be separated from other dangerous goods by 3 metres;
- gas cylinders shall not be stored less than 1 m from any door, window, air vent or duct; and
- all gas cylinders shall be secured in the upright position by chain or other means to prevent falling.

11.3 Storage Facilities

All facilities intended for the storage or for venting of cylinder contents will be specifically designed, approved, located and constructed to meet legislative and *AS 4332* requirements.

11.4 Moving Gas Cylinders

Statistics confirm that the majority of accidents involving gas cylinders occur while moving a cylinder from one location to another.

At SCU the following risk control measures must be used when moving gas cylinders:

- only properly trained personnel are permitted to move gas cylinders;
- only purpose-built and serviceable trolleys are to be used for gas cylinder transportation;
- gas cylinder isolation valves are to be closed or isolated and not leaking prior to movement; and
- all associated distribution equipment is to be disconnected and removed before moving the cylinder.

11.5 Indoor Storage of Gas Cylinders

Any proposal to incorporate indoor storage of gas cylinders shall be subject to the outcome of a formal risk assessment.

Notwithstanding the outcome of any risk assessment, the following requirements will govern the indoor storage of gas cylinders:

- the total capacity of gas in cylinders allowed for in any particular indoor location shall include cylinders in use, spare cylinders not in use, and used cylinders awaiting removal;
- the total capacity of the gases kept shall not exceed one minor storage quantity per 200 m2 of floor area (see below);

- where the floor area exceeds 200 m2 a further risk assessment will be undertaken prior to creating another storage area;
- indoor minor stores of gases in cylinders shall be separated from other minor stores of gases or other dangerous goods stores by a minimum distance of 5 m;
- there shall be no indoor storage in basements; and
- where cylinders are kept inside a confined area (e.g. a large cabinet or store) the area shall be adequately ventilated by natural air movement.

The guidelines for the storage of gas cylinders are detailed in *AS 4332*.

The following table outlines the quantities described as 'minor storage' of gases in cylinders:

Class of Gas	Maximum aggregate water capacity (L)
2.1	500
2.2	2000
2.2 *(with class 5.1 Subsidiary risk)*	1000
2.3	50

Where gases of mixed classes are kept in minor storage, the aggregate quantity of all gases shall not exceed 2000L and the quantity of each subclass shall not exceed that given in the table above.

11.6 References

AS 4332-2004/Amdt 1-2005 - The storage and handling of gases in cylinders

12 Cryogenic Fluids

12.1 Introduction

Cryogenic fluids are defined as fluids having a boiling point below -150°C at atmospheric pressure. Cold contact burns, frost bite, suffocation, lung disorder and general body cooling can result from exposure to cryogenic fluids. Common examples of cryogenic fluids used in the laboratory include helium, hydrogen, nitrogen, fluorine, argon, oxygen and methane.

Liquid oxygen and liquid hydrogen also present a significant fire hazard and although liquid nitrogen is not itself flammable, it is sufficiently cold to condense oxygen out of the atmosphere thereby creating a greater fire hazard. The following procedures should be followed when handling cryogenic fluids.

12.2 General Procedures

All systems of work that involve the handling, storage and use of cryogenic fluids will be the subject of a risk assessment.

Under no circumstances will cryogenic fluids be handled by any person without appropriate eye and hand protection including:

- full-face shield or goggles at any time when spraying or splashing may occur (e.g. transfer of liquids, immersion of objects);
- using clean dry insulated gloves when carrying cryogenic fluids in containers and during transfer operations;
- using appropriate safety clothing that minimises the formation of traps capable of holding liquid near the skin; and
- wearing enclosed footwear.

Bulk pressurised storage units containing cryogenic fluids should be kept in a locked compound with access restricted to trained staff.

Emergency, safety and transfer instructions should be clearly displayed near the units.

The need to implement additional safety precautions and/or protection will be dependent upon the outcome of the risk assessment, the particular operation being carried out and the quantity of liquid involved.

Typical additional safety precautions and/or protection may include but not necessarily be limited to:

- modifying an experiment or practicum so that the need to use cryogenic liquids can be eliminated entirely, or the volume of cryogenic fluids is reduced to the lowest possible level;
- reducing the number of staff and/or students who need to be exposed to cryogenic fluids by conducting a single demonstration rather than several independent experiments or practicums that require the use of cryogenic fluids;
- using suitable tongs and gloves when withdrawing objects immersed in cryogenic liquids;
- hold cold equipment for a short time only, even when using gloves;
- never allow bare skin or thinly protected skin to touch uninsulated pipes or vessels containing cryogenic liquids;
- using stable trolleys to transport larger storage vessels;
- using cryogenic fluids in a well-ventilated area.

12.3 Storage

Only containers specifically designed for holding cryogenic fluids should be used for storage (e.g. Dewar flasks). Recommended safety precautions and instructions from manufacturers of such vessels should always be consulted and followed.

Vessels should be handled with care to avoid bumping and jarring.

Depending on the nature of the cryogenic material, containers should be left open or protected by a vent or other safety device to allow vapours to escape and thus prevent excessive gas pressure. Vents should be regularly checked to ensure that a plug of frozen material has not formed. If a frozen plug has formed it should only be removed by a person skilled in the procedure.

Small containers should be stored so as to prevent contact with rain or moisture.

Areas where cryogenic liquids are stored and/or used shall be well ventilated to prevent the accumulation of gas or vapour that may evaporate from the liquid and reduce the oxygen content of the surrounding air to potentially dangerous levels.

12.4 Transferring Cryogenic Fluids

Techniques for transferring cryogenic fluids will be considered as part of any risk assessment.

Notwithstanding the outcome of a risk assessment, the following transfer techniques must be taken into consideration as hazard control strategies when transferring cryogenic fluids to secondary containers:

- pressurisation (conventional method) for transferring from a storage container to another vessel - using pressure created by heat leak into the storage container, by a heat source within the container, or by pressurisation with a gas corresponding to the liquid product. Always refer to the manufacturer's instructions;
- submersible electrically operated pump for the transfer of liquid nitrogen, though precautions will be required to prevent condensate entering and freezing in the pump, especially when changing containers. This method is not recommended for liquid oxygen transfers;
- the use of transfer tubes approved by the supplier of the cryogenic container(s);
- if pouring, use a filling funnel with the top of the funnel partly covered to reduce splashing; and
- transfer of cryogenic liquids must be carried out in a well-ventilated area.

All equipment such as cryostats and liquefiers must always be operated and maintained in accordance with the manufacturer's instructions.

12.5 Working at Reduced Pressure

Should the pressure on a cryogenic liquid be reduced below atmospheric, the following additional precautions will be taken:

- check that the system is vacuum-tight to prevent moist air being drawn in and forming ice plugs;
- provide a protective screen when working with glass dewar flasks;
- carefully control initial pumping speed to avoid pressure oscillation and liquid entrapment; and
- prevent violent boiling of superheated liquid by inserting boiling centres, compatible with the liquid in use, inside the dewar flask. This precaution is especially necessary when working with nitrogen in a glass system.

12.6 Special Precautions

Special requirements for some cryogenic fluids are set out as follows.

- Oxygen: High concentrations of oxygen support violent combustion. Liquid oxygen should not come into contact with organic material or flammable substances; and
- Nitrogen: Liquid nitrogen may become contaminated with atmospheric oxygen that has condensed from the air. Oxygen enrichment may be indicated by a blue tinge in the liquid. If the oxygen content of liquid nitrogen becomes appreciable, the precautions for liquid oxygen should be followed.

For additional information refer to *AS 1894 -1997, AS/NZS 2243.10* and section 4.4 of *AS/NZS 2243.2*.

12.7 References

AS 1894-1997/Amdt No. 1-1999: The storage and handling of non-flammable cryogenic and refrigerated liquids
AS/NZS 2243.2:1997: Safety in laboratories – Chemical aspects
AS/NZS 2243.10:2004: Safety in laboratories - Storage of chemicals

13 Chemical Safety

13.1 Introduction

SCU has certain legal obligations under the *WHS Regulation 2011* relating to chemical management and in particular the management of hazardous chemicals in the workplace. These obligations include the need for persons in control of the workplace or work area to produce and/or make readily available to all persons the following information for all such substances that are kept or used in the workplace:

- a register of hazardous chemicals and dangerous goods used in the workplace (OCID);
- appropriate SDS (not older than 5 years) for each hazardous chemical and dangerous good, from the manufacturer or supplier;
- risk assessment reports for each hazardous chemical detailing appropriate risk control measures (Refer to Section 13.4 Risk Assessments);
- appropriate labels on containers compiled in accordance with the approved Code of Practice as required by the Regulation;
- appropriate emergency procedures; and
- any other relevant information.

13.2 Register of Hazardous Chemicals and Dangerous Goods

13.2.1 Introduction

The University is required to establish and maintain a register of any hazardous chemical used in the workplace.

To meet the legislative requirements SCU uses a consolidated register, the Online Chemical Inventory Database (OCID). Refer to Section 13.8.4 Legal Obligations.

13.2.2 Online Chemical Inventory Database (OCID)

To facilitate the establishment and ongoing maintenance of the OCID Work Units must designate a person who will remain responsible for maintaining the register of hazardous chemicals and dangerous goods for each location and keeping this up to date. For further information on the OCID and how to update the register please contact the Workplace Health and Safety Team

13.2.3 Database requirements

The register of hazardous substances and dangerous goods must be readily accessible to all persons who may come into contact with these substances. The OCID is to be reviewed and updated annually.

When adding a hazardous substance to the OCID it must contain the following information:

- product name and/or common name;
- proper shipping name;
- hazardous substance and/or dangerous goods class classification;
- UN Number;
- packing Group;
- the relevant SDS;
- normal quantity held;
- storage location;
- storage (depot) type; and

- the relevant risk assessment for each substance – refer to Section 13.4 Risk Assessments.

13.3 Safety Data Sheets

13.3.1 Introduction

A Safety Data Sheet (SDS) provides critical information required for the safe handling of chemicals used in the workplace, including chemical and physical properties, health hazard information, emergency procedures and safe storage, use, handling and disposal procedures.

It is mandatory that there is a relevant SDS for each hazardous substance and dangerous good used in the workplace and that they are readily accessible to persons working with these substances.

Any person required to access and refer to a SDS should be trained in how to do so.

13.3.2 Obtaining a SDS

It is recommended that prior to the first purchase of a hazardous substance or dangerous good for use within the University, a SDS be obtained from the supplier or manufacturer of the substance. This will allow preliminary assessment of the health risks posed by the substance, and suitability for use within the University.

SDS obtained from a manufacturer or supplier must be produced in the approved format as detailed in the *Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals*.

A Safety Data Sheet must be provided with all first purchases or deliveries of hazardous substances and dangerous goods. There is no need to include a SDS with every delivery, unless the information contained in the SDS has been revised. All first purchase orders placed shall include an instruction 'SDS to be supplied'. A replacement or updated SDS should be requested as required.

The Workplace Health and Safety website provides access to a chemical information system called *ChemWatch*. The SCU subscription permits access to a database of independently reviewed SDS rather than original unedited SDS from suppliers.

13.3.3 Updating a SDS

It is a legal requirement for SDS to be updated at least every five years, and whenever new information about the substance becomes available. Do not accept SDS where the issue date is greater than five years.

Copies of manufacturer's and importer's SDS must be readily available to all that are required to use or handle the substance. Access may include paper copies, or computerised SDS databases (e.g. ChemWatch available through the Workplace Health and Safety website).

SDS should also be readily accessible to emergency services.

For further information refer to CoP for the Preparation of Safety Data Sheets for Hazardous Chemicals

13.4 Risk Assessments

13.4.1 Introduction

It is a legal requirement under the *WHS Regulation 2011* for SCU to manage risks associated with using, handling, generating and storing a hazardous chemical.

The sections below cover risk assessments for hazardous chemicals in storage and use as individual items. If however you plan to conduct work with a number of these substances and goods, as is commonly the case in laboratory environments, then a separate Laboratory Risk Assessment Form must be completed for each application (Refer to Section 8.2 Laboratory Risk Assessment & Control Protocol).
Risk assessments must be reviewed once every five (5) years or at other times as required by legislation.

13.4.2 Risk Assessments for Hazardous Substances

Risk assessments for hazardous substances relate to the **use** of the hazardous substance.

Results of risk assessments must be recorded in a local register (refer to section 13.2) by:

- making a notation to follow the SDS if the hazardous substances is kept and used, has no additional control measures necessary to control the risks associated with exposure to the hazardous substance other than those outlined in the SDS; or
- preparing a risk assessment report if additional measures are required to control the risks associated with exposure to the hazardous substances, and attaching it to the register.

Any risk assessment reports prepared for hazardous substances in a designated work area must be readily accessible to all persons working with or with the potential for exposure to the hazardous substance.

In addition to the above requirement for a risk assessment to be attached to the register for all hazardous substances, a Laboratory Risk Assessment (LRA) must be completed for each application where a hazardous substance is used.

13.4.3 Risk Assessments for Dangerous Goods

Risks associated with dangerous goods will be proportional to the overall quantity of dangerous goods stored or handled. Therefore risk assessments will depend on the total quantities of each class of dangerous goods stored or handled.

Dangerous goods stored or handled in a designated work area must have the results of a risk assessment or any review of a risk assessment recorded in a local register (refer to Section 13.2 Register of Hazardous Chemicals and Dangerous Goods by:

- making a notation to follow the SDS if the storage and use of the dangerous good is in line with the manufacturer's recommendations, or
- preparing a risk assessment report if additional measures are necessary to control the risks associated with the storage or handling of the dangerous goods, and attaching it to the register.

Any risk assessment reports prepared for dangerous goods in a designated work area must be readily accessible to all persons storing and handling the dangerous goods.

In addition to the above requirement for a risk assessment to be attached to the register for all dangerous goods, a Laboratory Risk Assessment (LRA) must be completed for each application where dangerous goods are used (Refer to Section 8 Risk Management).

13.5 Labeling

13.5.1 Introduction

All containers used for the storage of chemicals and reagents must be labeled in accordance with the relevant regulations.

13.5.2 Protocols

The protocol to be followed when labelling containers for the storage of chemicals is described in the *Labelling of Workplace Hazardous Chemicals Code of Practice*.

WHS Regulation 2011, Part 3 of Schedule 9: A hazardous chemical is correctly labeled if the chemical is packed in a container that includes the following:

- is written in English
- the product identifier
- the name, Australian address and business telephone number of either the manufacturer or importer
- the identity and proportion disclosed, in accordance
- Labels for containers with the **capacity of less than 500 mL(g)** should provide the following information:
    - signal word(s) and/or dangerous goods class and subsidiary risk label(s) (where applicable);
    - chemical name;
    - risk phrases;
    - safety phrases
    - first aid procedures;
    - details of manufacturer or importer;
    - reference to SDS.

DECANTED MATERIALS NEED THE FOLLOWING INFORMATION:

- chemical name;
- risk phrases;
- safety phrases.

In the case of test tubes or other small containers (e.g. rack of test tubes containing the same material) a tag with the appropriate information attached to the rack is sufficient.

13.6 Storage & Handling of Chemicals

13.6.1 Introduction

The University uses a wide range of chemicals for the purpose of conducting laboratory experiments. Quantities of chemicals kept in laboratories should be sufficient for day-to-day use and every effort should be made to minimise the amount of chemicals that are to be stored in laboratories.

13.6.2 General Requirements

At SCU the following general requirements shall apply to the storage and handling of chemicals in laboratories:

- chemicals shall be segregated according to their dangerous goods class and stored separately to minimise risk of interaction;
- ensure that incompatible substances are stored and/or handled separately in order to prevent interaction; *Managing Risks of Hazardous Chemicals Code of Practice*;
- safety data sheets (SDS) for all hazardous substances and dangerous goods must be readily available to all personnel;
- all chemicals shall be kept in a secure lockable storage area which is suitably identified and not exposed to direct light or heat;

- all chemical storage containers should be appropriately labelled. Refer to Section 13.5 Labelling;
- special storage requirements as recommended in SDS shall be followed;
- volatile and toxic materials may require special storage (refer to SDS for details);
- class 8 Dangerous Goods (corrosive substances) should be stored in approved corrosives or acid cabinets;
- small quantities of acids may be stored on suitable spill capture trays in under-bench storage;
- most other chemicals can be stored on shelves in a designated chemical storage area. Spill containment trays should be used for storage of chemicals on shelves;
- measures must be put in place to control the risks arising from a potential spill or leak of chemicals. Appropriate containment should be considered for any location where dangerous goods or hazardous substances are stored or handled;
- all containers of liquids should be stored on lower shelves;
- refrigerated storage of chemicals may be required, however, domestic refrigerators must not be used for the storage of flammable chemicals;
- poisons and drugs should be stored according to relevant statutory requirements;
- storage facilities shall be designed and constructed of a suitable material in accordance with Australian Standard design and construction criteria;
- when transporting dangerous goods they must be packaged in approved containers that are in good condition and properly closed to prevent leakage, spillage or shifting during transport;
- transfer operations must eliminate or control the risks associated with possible:
    - spills and/or leaks;
    - static electricity; and
    - vapour generation.

13.7 Induction and Training

Induction and training is to be provided to all staff and postgraduate students whose work potentially exposes them to hazardous substances and dangerous goods in the workplace. The relevant supervisor, research supervisor or technical manager is responsible for the induction and training of staff and/or students in their area of control. The induction program is to include:

- storage and handling of hazardous substances and dangerous goods;
- labelling of substances and containers;
- SDS availability and information about hazardous substances and dangerous goods;
- details on the risk assessment process;
- work practices and procedures (e.g. Safe Work Procedures) for all stages in the use of hazardous substances and dangerous goods;
- control measures;
- correct use of personal protective equipment;
- emergency procedures;
- first aid and incident reporting;
- details of monitoring and health surveillance (refer to *Guidelines for Health Surveillance [NOHSC:7039 (1995)],);* and
- other details regarding the rights and obligations of employees and students using the substances.

Records of training must be kept by the relevant person(s) in control of the work area, and should include the names of those who have received the training, an outline of the course content, and the names of those providing the training. These records are required to be kept for at least five (5) years after the date of the creation of the record.

13.8 Dangerous Goods

13.8.1 Introduction

Dangerous Goods are a specific category of substances and items that are given prominence because of the **acute** effects a single exposure and/or incident may have on life, health, property or the environment**.**

The Australian Dangerous Goods Code for the Transport of Dangerous Goods by Road or Rail establishes a hazard recognition system for dangerous goods with recommendations for the classification of dangerous goods based on the following criteria:

- the predominant hazard of the material (Dangerous Goods Class);
- a labelling and placarding system for identifying hazards that is internationally recognised;
- a numbering system (UN number) that uniquely identifies specific chemicals or groups of products with the same hazards;
- the division into three hazard groups (packing group) in order to recognise the degree of danger or risk;
- the requirements for the use of approved packaging and storage containers.

13.8.2 Classification

There are 9 Classes of dangerous goods with a particular category of hazard:

Class 1	Explosives
Class 2	Gases
Class 3	Flammable Liquids
Class 4	Flammable Solids
Class 5	Oxidising Substances and Organic Peroxides
Class 6	Toxic or Infectious Substances
Class 7	Radioactive Substances
Class 8	Corrosive Substances
Class 9	Miscellaneous Dangerous Goods

Each dangerous goods class has a coloured hazard label that is denoted by a dangerous goods hazard 'diamond' or class label, containing a diagram or symbol of the class hazard, class name and class number (Refer to Dangerous Goods Diamonds).

Some dangerous goods may also possess additional hazard characteristics (subsidiary risks) that can also be displayed using a second smaller diamond.

Refer to Dangerous Goods Placard and *Class Labels for Dangerous Goods AS 1216:1995*.

13.8.3 Packing Groups

Some dangerous goods classes (Classes 3, 4, 5, 6.1, 8 and 9) are divided into three Packing Groups designated in decreasing order of risk:

- Packing Group I — Great danger or severe risk of poisoning
- Packing Group II — Medium danger or serious risk of poisoning
- Packing Group III — Minor danger or relatively low risk of poisoning

13.8.4 Legal Obligations

The storage and handling of dangerous goods is regulated by the *WHS Regulation 2011*.

The legislation adopts a risk management approach to the storage and handling of dangerous goods in the workplace, and is based upon the *National Standard for the Storage and Handling of Dangerous Goods (2001)*. Refer also to Section 13.1 Introduction.

There are additional requirements regarding placarding, manifests and notification to SafeWork NSW and WorkSafe QLD dependant on the quantities of dangerous goods stored or handled at each campus of SCU. 'Placard Quantities' and 'Manifest Quantities' can be found in Schedule 11 *WHS Regulation 2011*.

Placards (designed in accordance with Schedule 13 of the *WHS Regulation 2011* must be displayed at:

- all road entrances to SCU premises if the total quantity of dangerous goods stored or handled at that premises exceeds the "placard quantity" for any item;
- each location where dangerous goods are found in bulk; and
- each location where packages of dangerous goods are stored and handled, if the total quantity in that location exceeds the 'placard quantity'.

Additional requirements exist for premises where dangerous goods are stored and handled above 'Manifest Quantities'. This involves notification to SafeWork NSW by the submission of a manifest, plan of premises and a written emergency plan. The WHS Unit will determine if manifest quantities of dangerous goods exist at any campus of the University, using the OCID register (refer to Section 13.2 Register of Hazardous Substances and Dangerous Goods), and liaise directly with persons in control of these dangerous goods in the preparation of the notification to WorkCover.

Further general obligations required under the Dangerous Goods Regulation are described in Section 13.1 Introduction.

13.8.5 Plant, equipment and containers

If dangerous goods are to be used with plant or equipment, refer to the manufacturer's instructions for the plant or equipment provided by the supplier. Hazards and risks associated with the plant itself that could impinge on safety with dangerous goods must be assessed and controlled. Further advice is provided in the *WHS Regulation 2011*.

Any plant, equipment or container used in connection with dangerous goods that:

- is to be disposed of, or
- has not had dangerous goods placed in it or taken from it for a continuous period of 12 months,

is to be made free from the dangerous goods or made safe.

Any dangerous goods container that has been made free from dangerous goods, and is to be reused for another purpose, must have all references, signs, or warnings relating to the dangerous goods removed or obliterated.

13.9 Hazardous Substances

13.9.1 Introduction

A hazardous substance is any substance that has the potential to harm the health or safety of persons in the workplace. As such, many dangerous goods are also hazardous substances.

A hazardous substance can be a single chemical entity or a mixture; it can be purchased from a manufacturer or supplier or produced at the workplace by chemical processes.

The criteria for identifying hazardous substances are detailed in the National Occupational Health and Safety Commission's *Approved criteria for classifying hazardous substances* [NOHSC:1008 (2004)] 3rd Edition.

Safe Work Australia has an online resource called the Hazardous Substance Information System (HSIS). The HSIS allows you to find information on substances that have been classified in accordance with the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004] *3rd Edition* and/or have National Exposure Standards declared under the NOHSC *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1995)]. *NOHSC Hazardous Substances Information System* (HSIS).

13.9.2 Legal Obligations

The *WHS Regulation 2011* provides for the management of hazardous substances in the workplace. It is based on the *National Model Regulations for the Control of Workplace Hazardous Substances [NOHSC:1005 (1994)].*

General obligations for hazardous substances and dangerous goods required under the Regulation are described in Section 13.1 Introduction.

There are additional obligations when using hazardous substances in the workplace:

- health surveillance, if required as a result of a risk assessment, must be performed in accordance with the *WHS Regulation 2011*;
- health surveillance must be provided to employees exposed to a hazardous substance if there is a risk to the health of that employee as a result of exposure, and:
- the hazardous substance is listed in schedule 14, table 14.1 column 2, *WHS Regulation 2011*;
- Schedule 10 *WHS Regulation 2011* identifies hazardous chemicals which have use restrictions. These identified substances are not to be used for the identified purposes.
- certain records must be retained as follows:
- records associated with the use of prohibited or notifiable carcinogens or hazardous chemicals must be kept for 30 years after the last entry date.

13.10 Carcinogenic, Mutagenic and Highly Toxic Substances

13.10.1 Introduction

Carcinogenic substances are hazardous substances that are capable of inducing cancer in humans. Highly toxic substances include mutagens (substances that permanently alter the amount or structure of the genetic material in an organism), teratogens (substances capable of producing malformation in the developing embryo or foetus) and cytotoxic drugs (agents that are known to be toxic to cells). Every effort must be made to use non-carcinogenic, non-mutagenic, non-teratogenic or less toxic substances in the workplace.

The *National Model Regulations for the Control of Workplace Hazardous Substances [NOHSC:1005 (1994)]* and the *National Code of Practice for the Control of Workplace Hazardous Substances [NOHSC:2007 (1995)]* establishes provisions to minimise risks to health arising from any work involving hazardous substances. All such provisions apply to carcinogenic and other highly toxic substances as for all hazardous substances.

The guidelines for the use of carcinogenic substances below may also be applied to the use of other highly toxic substances, such as mutagens, teratogens or cytotoxic drugs.

13.10.2 Legal Obligations

The *Approved Criteria for Classifying Hazardous Substances [NOHSC:1008 (2004])* have identified carcinogenic substances and placed them into three categories:

- Category 1 - Substances known to be carcinogenic to humans;
- Category 2 - Substances that should be regarded as if they are carcinogenic to humans; and
- Category 3 - Substances that cause concern for humans due to their possible carcinogenic effects, however, the available information is not adequate for making a satisfactory assessment.

Some carcinogenic substances have been 'scheduled' and are subject to prohibition and notification requirements in order to eliminate or minimise risks to health and impose stricter controls on their use at work. These requirements are established in the *National Model Regulations for the Control of Scheduled Carcinogenic Substances [NOHSC :1011 (1995)].*

Practical guidance on how to comply with the prohibition and notification requirements for scheduled carcinogenic substances is explained in the *National Code of Practice for the Control of Scheduled Carcinogenic Substances [NOHSC:2014 (1995)]*. This CoP also explains the specific requirements for assessment and control of risks arising from work with scheduled carcinogenic substances, and the specific requirements for record keeping.

Before proposing to conduct work involving the use, production, handling, storage, transport or disposal of a carcinogenic substance, a rigorous risk assessment must be undertaken.

The risk assessment must take into consideration the likely routes of exposure and the potential effectiveness of available control measures.

There are two types of listed carcinogens under the WHS Regulation which require approval from the Head of Work Unit and notification to the appropriate regulatory body (SafeWork NSW or WorkSafe QLD):

- notifiable carcinogens (those which can be used); and
- prohibited carcinogens (those which are prohibited except for research and analysis).

These carcinogenic substances are listed in the *WHS Regulation 2011*.

Work involving the use of any of the listed carcinogens or known mutagenic, teratogenic or cytotoxic substances **must not proceed until** approved by the Head of Work Unit and notification to the appropriate regulatory body is made at least 60 days before commencement of the work using the approved '*Use of Carcinogenic Substances Notification Form*'.

See also SafeWork NSW: Guidelines for Notification *('Guide for notifications of work involving carcinogenic substance 2009*'.

Records must be kept in respect of employees who are exposed to prohibited or notifiable carcinogenic substances in accordance with the *WHS Regulation 2011*.

Any records relating to work using carcinogens that require health surveillance of personnel or workplace monitoring must be kept for at least 30 years (see section 11: *National Code of Practice for the Control of Workplace Hazardous Substances)*. Such work must also be notified to the SCU laboratories Technical Manager.

A review of any risk assessments involving carcinogens should be undertaken at least every five (5) years and the appropriate regulatory body should be informed of any such review.

When a carcinogenic substance(s) is acquired a register must be established that details the following information:

- the initial acquirer's name and contact number;
- the date the initial quantity of the substance was first acquired by the person;
- the initial quantity of the substance acquired by the person;
- the date(s) of any subsequent uses of the substance by any person(s);
- the name(s) of any person(s) using the substance subsequent to its initial acquisition; and
- the quantity(ies) of substance used by the person(s) on each subsequent occasion the substance is used.

13.10.3 General Safety

For all work using carcinogens and other highly toxic substances, the laboratory/research/academic supervisor is responsible for ensuring that:

- the risk control measures called for in the risk assessment are strictly adhered to;
- anyone working with carcinogens understands the nature of the hazard and the likely adverse health effects that may occur from exposure;
- the specific hazard control measures that they are to adopt to eliminate or minimise exposure;
- adequate training is provided to enable any person using the substance to do so safely; and
- a register is kept, which records the acquisition, use and disposal of the substance(s) - see 13.10.2.

If possible, carcinogenic substances should only be used in laboratory areas specifically designed for that purpose. Access to those areas should be limited to persons directly involved in the work.

Warning signs displaying the following information should be placed on doors leading to the work area:

- a general warning (e.g.: 'Caution – Limited Access. Chemical Carcinogen In Use'); and
- the name and contact details of an appropriate person who can be contacted in an emergency.

Work using carcinogens should be conducted on a spill tray, and all working surfaces covered with a plastic-backed absorbent material. The protective material should be replaced regularly or immediately after a spill.

Facilities for dispensing carcinogens and other highly toxic substances should be available in the same area where the chemicals are stored. Only the minimum amount required should be taken, and the aliquot taken should be recorded and clearly labelled.

Biological safety cabinets should NOT be used for work with carcinogens. Work that may generate dust, vapour or aerosols should be performed in a suitably modified fume cupboard (refer to *AS/NZS 2243.8*) or in a cytotoxic cabinet (refer to *AS 2567*).

Appropriate PPE must be used when handling carcinogens. Refer to the relevant SDS for guidance. The PPE should be stored near the work area and used only for the intended purpose. Laboratory coats should be removed before leaving the laboratory.

Any maintenance work to be conducted in a laboratory facility where carcinogenic substances are stored or used must be notified to the appropriate Technical Manager or supervisor for the appropriate safety induction training prior to commencement of the work.

13.10.4 Storage and Labelling of Carcinogens

All carcinogenic chemicals must be stored in closed, sealed containers, appropriately labelled with the following information:

- chemical name;
- physical form;
- date of acquisition;
- nature of hazard; and
- appropriate risk label.

The primary container should be stored and at all times transported in an appropriately labelled secondary container.

Carcinogenic chemicals should be stored in a secure area separate from the general chemical store and be separated from other chemicals whilst in the laboratory.

13.10.5 Contamination with Carcinogens

All persons should, after using carcinogens, wash hands in cold water, followed by warm water and soap.

Accidental skin contact should be treated immediately by rinsing with cold running water for at least 5 minutes, followed by a thorough wash with soap and warm water. Eyes should be irrigated with running water for at least 15 minutes.

Glassware and equipment should be decontaminated with the appropriate chemical treatment or washed with a suitable chemical solvent. This should be followed by a rinse in cold running water, a wash and brush in hot water and detergent, and the laboratory's routine washing procedure.

Work surfaces, although protected by absorbent material, should be regularly wiped with cold water, followed by warm water with detergent.

PPE, including laboratory coats, should be cleaned and laundered separately and appropriately.

13.10.6 Monitoring for Carcinogens

The need for biological monitoring, environmental and/or medical examination of personnel must be considered as part of the risk assessment. If biological monitoring, environmental and/or medical examination of personnel is required then systems must be established before any work with carcinogenic substances commences. The results of workplace monitoring and medical surveillance should be kept for at least 30 years.

For further information refer to *Guidelines for Health Surveillance [NOHSC:7039 (1995)]* and SafeWork NSW: *'Guide for notifications of work involving carcinogenic substance 2009*'.

13.10.7 Disposal of Carcinogens

Liquid wastes containing carcinogenic chemicals should be collected in approved disposal containers that are sealed and secured, labelled appropriately, and placed in a secondary labelled container.

Contaminated solid wastes, including disposable PPE, absorbent paper, residue from spills, exhaust air filters, animal carcasses and associated material, should be double-bagged, appropriately labelled and stored prior to disposal.

All waste contaminated with carcinogens should be disposed of through an approved waste disposal contractor. See also Section 16 Disposal of Laboratory Wastes.

13.11 Poisons & Drugs

Poisonous substances and drugs are regulated through the *Poisons and Therapeutic Goods Act 1966* and the *Poisons and Therapeutic Goods Regulation 2008* that specifies a 'Poisons List' and allocates poisons and drugs into one of nine 'Schedules' according to factors such as toxicity, danger to life, potential for abuse, safety, etc.

If a substance is listed in a schedule it is deemed to be a 'poison' or a 'drug' and is therefore bound by the Act and Regulation.

The schedules determine the degree of control over the listed substances including their availability to the public, requirements for labelling and appropriate containers. The controls increase with the schedule number so that Schedule 9 substances 'Drugs of Abuse' should only be available for research and other defined restricted purposes.

Most poisons in Schedules 5, 6 and 7 are also hazardous substances and therefore their purchase, storage, labelling, handling and disposal is bound by the hazardous substances legislation. See Section 13.9 Hazardous Substances.

For further information on hazardous substances including carcinogens refer to the following publications:

- *National Code of Practice for the Control of Workplace Hazardous Substances [NOHSC:2007 (1995)]*
- *National Model Regulations for the Control of Scheduled Carcinogenic Substances [NOHSC :1011 (1995)]*
- *Guidelines for Health Surveillance [NOHSC:7039 (1995)]*

13.12 Regulation of Security Sensitive Ammonium Nitrate (SSAN)

13.12.1 Introduction

Ammonium nitrate, a hazardous substance and dangerous good, is commonly used as an explosives ingredient in the mining industry. It is also a major component of agricultural fertilizers. It is relatively stable until mixed with a fuel to initiate an explosive charge, and as such is classified as an explosives precursor.

On 25 June 2004 the Council of Australian Governments (COAG) agreed to a national licensing system to limit access to explosives precursors that could be used for terrorist purposes. Each state and territory has now introduced legislation and/or regulations to give effect to the COAG agreement.

Ammonium nitrate has been identified as a 'security sensitive dangerous substance' (SSDS) by COAG and is classified as 'security sensitive ammonium nitrate' (SSAN).

In NSW, SSAN is regulated through the *Explosives Act 2003* and the *Explosives Regulation 2005* and through the *Explosives Act 1999* in QLD.

"SSAN" includes ammonium nitrate (i.e. 100%, pure ammonium nitrate), ammonium nitrate emulsions and ammonium nitrate mixtures containing greater than 45% ammonium nitrate, excluding solutions and class 1 explosives. (Note: This includes substances such as calcium ammonium nitrate that are not classified as dangerous goods and dangerous goods with UN numbers 1942, 2067, 2068, 2069, 2070, 2071, 2072, 3375 and 3139 where applicable).

For further information refer to WorkCover publication *Secure and Safe Handling of Explosives and Security Sensitive Dangerous Substances*.

To ensure ongoing public safety and security, COAG will examine other substances of security concern that could be used as explosives precursors, to determine what security controls are warranted regarding their handling and use. Other chemicals, biological agents and radiological materials may be identified in the future for government regulation through this process.

13.12.2 Licencing Requirements

In NSW and QLD, a licencing regime has been established for the import, export storage, transport, sale, supply, purchase, acquisition, use and disposal of SSAN. This has come into effect on 1 July 2005.

It is now illegal to purchase, possess or use SSAN until the licensing requirements have been met and an official licence obtained. The licensing requirements are set out in the Workplace publication *Ammonium Nitrate Guidance Note No.2 Storage*.

The licencing requirements are quite stringent and include licence fees for each activity, security plans, secure storage, police and security checks of authorised personnel, record keeping, reporting of loss or theft to authorities etc. This should be a major consideration in the design stage and risk assessment process of any work where SSAN is planned to be used in the University.

Whilst the University does not prohibit the use of SSAN, it strongly recommends that SSAN products be substituted for non-regulated products such as fertilizers with less than 45% ammonium nitrate and other non-regulated chemicals used in teaching and research.

13.12.3 Licencing Exemptions

The explosives legislation allows an exemption from licencing for educational, research or analytical purposes at a university or research institution, if the amount of SSAN stored and used does not exceed **3 kg**. For SCU this amount is the limit for any one site.

If you currently use or plan to use SSAN, the Technical or laboratory Manager must be contacted immediately so that licencing implications can be assessed if total quantities of SSAN exceed 3kg at any one storage facility.

13.13 Flammable Liquids

The following general rules apply to the storage, handling and use of flammable liquids:

- all work and learning that involves the handling, storage and use of flammable liquids will be subject to a risk assessment;
- quantities of flammable liquids are to be kept to an absolute minimum;
- the recommended day-to-day working allowance of flammable liquids in laboratories is considered ‘minor storage’. Minor storage limits are defined in AS 1940:2004 -The storage and handling of flammable and combustible liquids;
- potential sources of ignition are to be identified as part of the risk assessment and measures implemented to ensure that flammable liquids do not inadvertently come into contact with an ignition source;
- all electrical equipment used near or in conjunction with flammable liquids is to be spark proof;
- flammable liquids should never be stored in a domestic refrigerator as sparks from the internal light or motor may cause an explosion. Use an approved ‘explosion proof’ or ‘spark proof’ refrigerator for such storage;
- where a domestic refrigerator is installed a warning sign is to be displayed on the door indicating that ‘Flammable liquids must not be stored in this refrigerator’;

- when heating flammable liquids use only steam or water baths or heating mantles. Extreme care must be exercised to ensure that there is no source of ignition;
- appropriate spill kits, fire extinguishers and fire blankets must be easily accessible when handling flammable liquids;
- flammable liquids should not be stored in fume cupboards. *AS/NZS 2243.8:2001* -Safety in Laboratories – Fume Cupboards sets out a risk assessment process for the use of flammable liquids in fume cupboards;
- flammable liquids should be stored in an approved flammable liquid storage cabinet constructed in accordance with AS 1940:2004;
- quantities of Dangerous Goods Class 3 in excess of 250 litres must be stored in a licensed flammable liquids store or depot as per AS 1940:2004 and WorkSafe Australia requirements
- storage of Dangerous Goods Class 3 that exceeds 'placard' quantities is subject to placard and signage requirements as detailed in Chapter 15 of the WorkCover publication *CoP - Storage and Handling of Dangerous Goods, 2005*. (See also Section 13.8.4 Legal Obligations).
- quantities of Dangerous Goods Class 3 above 'manifest' quantities, stored in approved facilities, may be subject to notification requirements of the Dangerous Goods Branch of the WorkCover Authority (refer to WorkCover publication *CoP - Storage and Handling of Dangerous Goods (2005)* Chapter 16).

For additional information refer to *AS/NZS 2243.2* and *AS/NZS 2243.10.*

13.14 Chemical Spills

13.14.1 Introduction

Any person(s) in control of premises where chemicals are stored or handled must ensure that provisions are made for the containment of potential spills or leaks. This includes the provision of appropriate spill kits, spill clean up teams, emergency spills procedures etc. Refer to Section 5.8.4 Spills Management – Chemical Spills.

All chemical spills and leaks must be contained safely within a limited area of the premises as far as is reasonably practicable. Any area or receptacle intended to contain spills or leaks must not be shared with any other substances that are not compatible with the chemical to be contained.

Immediate action is to be taken (by the person(s) noticing the spill) to implement an effective clean up protocol as detailed in Section 5.8 Spills Management.

In the event of a spill or leak:

- any risk associated with the spill or leak must be immediately reduced; and
- the chemicals and resulting effluent are cleaned up and disposed of or made safe as far as is reasonably practicable.

All spill incidents must be reported to the Technical or Laboratory Manager so that the circumstances that led to the spill can be determined and remedial measures implemented to prevent a recurrence.

13.14.2 Spill Kits

Spills control kits must be strategically placed in key areas of the laboratory and are only to be used for spill management and control. The content of the kits will be determined depending on the outcome of the laboratory spill risk assessment.

Not withstanding the outcome of a laboratory risk assessment, spill kits must (as a minimum) contain appropriate personal protective equipment, absorbents and neutralisers.

All kits must be regularly checked by Technical Staff to ensure that they remain appropriate for the type(s) of spill(s) that could occur, are complete, are serviceable and readily accessible at all times.

13.15 References

Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)
The Australian Dangerous Goods Code 7th edition
AS 1216:1995 - Class Labels for Dangerous Goods
AS 1940:2004 - The storage and handling of flammable and combustible liquids
AS 2567:2002 - Laminar flow cytotoxic drug safety cabinets
AS/NZS 2243.2:1997: – Safety in Laboratories – Chemical Aspects
AS/NZS 2243.8:2001: - Safety in Laboratories - Fume Cupboards
AS/NZS 2243.10:2004 – Safety in Laboratories – Storage of Chemicals
AS/NZS 3833:1998 - The storage and handling of mixed classes of dangerous goods in packages and intermediate bulk containers
NSW Explosives Act 2003
Explosives Regulation 2005
QLD Explosives Act 1999
Guidelines for Health Surveillance [NOHSC:7039 (1995)]
National CoP for the Control of Scheduled Carcinogenic Substances [NOHSC:2014 (1995)]
National CoP for the Control of Workplace Hazardous Substances [NOHSC:2007 (1995)]
National CoP for the Labelling of Workplace Hazardous Substances [NOHSC:2012(1994)]
National CoP for the Preparation of Material Safety Data Sheets [NOHSC:2011(1994)]
National Standard for the Storage and Handling of Workplace Dangerous Goods [NOHSC:2015 (2001)]
National Model Regulations for the Control of Scheduled Carcinogenic Substances [NOHSC :1011 (1995)]
National Model Regulations for the Control of Workplace Hazardous Substances [NOHSC:1005 (1994)]
NOHSC Hazardous Substances Information System
WHS Regulation 2012
SafeWork NSW CoP for the Control of Workplace Hazardous Substances (2006)
SafeWork NSW CoP for the Labelling of Workplace Substances (1996) SafeWork
NSW CoP for the Preparation of Material Safety Data Sheets (2006) SafeWork
NSW CoP for the Storage and Handling of Dangerous Goods (2005) SafeWork
NSW Guide Ammonium Nitrate Guidance Note No.2 Storage (2004)
SafeWork NSW Guide Secure and Safe Handling of Explosives and Security Sensitive Dangerous Substances (2005)
SafeWork NSW Guidelines for Notification - Work involving use of carcinogenic substances (2009)
SafeWork NSW Use of Carcinogenic Substances Notification Form
Poisons and Therapeutic Goods Act 1966
Poisons and Therapeutic Goods Regulation 2008

14 Biological Safety

14.1 Introduction

There are many biological hazards and biohazardous materials that can be encountered in University laboratories. These include microorganisms (viruses, bacteria, fungi), specimens of human origin (blood, blood products, other body fluids), animal blood or tissues, imported or quarantine biological materials and other biological agents that are potentially infectious or hazardous.

Laboratories where biological organisms, specimens or materials (biologicals) are used and stored must have the appropriate practices and equipment to manage the risks associated with those biologicals.

Southern Cross University has established Microbiology procedures to regulate all research and teaching proposals involving the use of certain biologicals and genetically modified organisms (GMOs).

Any type of laboratory teaching or research work involving genetic manipulation or the use of genetically modified organisms (GMOs) must comply with the requirements of the *Gene Technology Act 2000* and the *Gene Technology Regulations 2002* and the Office of Gene Technology Regulator (OGTR) Guidelines. For details refer to Section 14.4 Genetic Manipulation Work.

Therefore, work involving any of the following must not commence until approval has been granted from the Head of Work Unit:

- GMOs (e.g. recombinant DNA);
- microorganisms of risk group 2 or higher;
- whole microorganisms;
- imported biological products;
- specimens of human origin (blood/body fluids, blood products);
- cytotoxic substances (carcinogens, mutagens and teratogens);
- other potentially infectious or hazardous agents (including animal blood or tissues).

14.2 Work Practices

All biologicals should be regarded as potentially hazardous or infectious, therefore in addition to the general safety precautions the following practices must also be observed when working with these materials/agents.

- follow the SCU Safe Working Procedures and Microbiology Procedure for dealing with Specimens of Human Origin and/or Potentially Infectious and/or Hazardous Substances';
- never put your face near anything that can become contaminated from dirty surfaces e.g. pens, pencils, labels and even hands;
- disposable laboratory coats must be worn for all work involving the use of unscreened human blood and/or body fluids/specimens. Upon completion of work, these coats should be immediately disposed of as contaminated waste;
- laboratory gowns must be removed before washing hands when leaving the laboratory. Hands should be washed with a suitable disinfectant hand-wash before leaving the laboratory and immediately if they have become contaminated with blood or body fluids See Section 5.7 Needle-Stick Injuries and Other Biological Exposure;
- coats should be treated with disinfectant prior to laundering separately from other clothing. Coats should also be transported separately from other items (use a plastic bag). Laboratory coats that have been contaminated with materials of human origin must be autoclaved before laundering;
- significant spills and accidents must be reported immediately and the contaminated area is to be disinfected by trained staff (see Section 5.8.7 Biological Spills.);

- cultures of microorganisms must be clearly identified, dated and appropriately stored;
- benches must be wiped with disinfectant before and after work. The production of aerosols should be minimised, particularly when working on an open bench;
- fungal cultures in petri-dishes should be sealed with tape to prevent the dispersal of spores, which may be allergenic or possible contaminants;
- all open wounds are to be dressed and reported to the laboratory supervisor before commencing laboratory work;
- wear disposable gloves to avoid skin contact with biological specimens and surfaces or materials exposed to them. Gloves must be removed on completion of work and before performing office work and answering the telephone. Gloves must be disposed of as contaminated waste;
- surgical masks and additional protective eyewear should be worn where eyes or mucous membranes may be exposed to biological material through splashes or sprays;
- handle all sharp implements with extreme caution;
- microscopes and objectives should be cleaned after use. Immersion oil must be thoroughly removed;
- biological waste should be decontaminated before disposal (see Section 16 Disposal of Laboratory Wastes.)

14.3 Microorganisms

14.3.1 Introduction

All microorganisms should be regarded as potential pathogens and handled with standard microbiological techniques by trained persons in order to protect people, the environment and the purity of the isolate.

14.3.2 Risk Groups

AS/NZS 2243.3:2002 classifies microorganisms into risk groups, based on the agent's pathogenicity, mode of transmission and host range, and the availability of effective preventative measures and effective treatment. Corresponding safe work practices and containment levels for each group are also detailed:

- Risk group 1 microorganisms (low individual and community risk) are unlikely to cause disease in humans, plants or animals and may be used in Physical Containment 1 facilities See Section 14.3.3. AS/NZS 2243.3 does not provide examples of risk group 1 microorganisms as the list is extensive.
- Risk group 2 microorganisms (moderate individual risk, limited community risk) can cause human, plant or animal disease but are unlikely to be a serious threat to laboratory personnel, the community, livestock or the environment. Although exposure in the laboratory may lead to infection, effective preventative measures and treatment are available, and the risk of spreading the infection is limited. Tables 3.1, 3.2, 3.4, 3.5 and 3.7 in AS/NZS 2243.3 provide extensive lists of microorganisms categorised as risk group 2.
- Risk group 3 microorganisms (high individual risk, limited community risk) usually cause serious human or animal disease, and may present a risk if spread in the community. Effective preventative measures and treatment are usually available. AS/NZS 2243.3 lists examples of risk group 3 microorganisms in tables 3.3, 3.6 and 3.8.
- Risk group 4 microoganisms (high individual and community risk) usually cause life- threatening human or animal disease, and pose a serious hazard to laboratory personnel. The microorganism is easily transmitted, and effective preventative measures and treatment are usually not available.

AS/NZS 2243.3 also lists *risk-groups* microorganisms by type e.g. bacteria, fungi, parasites, viruses (See Clause 3.4).

Diagnostic specimens from humans or animals are normally regarded as risk group 2 and should be handled appropriately (i.e. in Physical Containment Level 2 facilities).

14.3.3 Physical Containment Levels

Not all laboratories operated within the University meet or are required to meet a specific containment level classification(s).

The OGTR however mandates that certain types of genetic manipulation work be undertaken in laboratories that are appropriately certified by the OGTR as meeting the physical containment levels specified in *AS/NZS 2243.3:2002.*

The Standard outlines the design and construction requirements and recommendations for laboratories to meet a particular physical containment level.

The Standard also outlines the types of work that should be conducted in a laboratory that meets a particular physical containment level having regard to the risk groups outlined above.

The information provided below provides a summary of the types of work that may be undertaken within a laboratory meeting a specific physical containment level:

- Physical Containment Level 1 (PC1) facilities are suitable for undergraduate teaching laboratories. They require no special containment equipment and are suitable for work with risk group 1 microorganisms. Work may be carried out on the open bench as long as hazard levels are low and standard laboratory practices are followed in order to protect laboratory personnel. Specimens that have been fixed or inactivated may be handled in a PC1 facility. Detailed requirements for PC1 laboratories are described in Clause 7 *AS/NZS 2243.3.*
- Physical Containment Level 2 (PC2) facilities are required for all work with risk group 2 microorganisms. Clause 4.7 in *AS/NZS 2243.3* details requirements for PC2 facilities. Under these conditions, work may be performed on the open bench as long as safe microbiological techniques are practised. However, if aerosol production is likely, a biosafety cabinet should be used.
- Physical Containment Level 3 (PC3) facilities incorporate all requirements and practices for PC1 and PC2 plus those in Clause 4.9 *AS/NZS 2243.3*. Work with risk group 3 microorganisms shall be carried out in PC3 laboratories in order to provide protection to individuals, the community and the environment.
- Physical Containment Level 4 (PC4) facilities are to be used for work with risk group 4 microorganisms and other dangerous agents. Due to the highly hazardous nature of this work, rigorous requirements must be adhered to in these facilities, as specified in Clause 4.10 *AS/NZS 2243.3*.

14.4 Genetic Manipulation Work

14.4.1 Introduction

Any work involving genetic manipulation or the use of genetically modified organisms (GMOs) is regulated by the *Gene Technology Act 2000* and the *Gene Technology Regulations 2002,* through the national Office of the Gene Technology Regulator (OGTR), whose legislative mandate is to 'prevent harm to human health and safety and the environment' by regulating use of GMOs in Australia'.

A genetically modified organism is defined as:

- an organism that has been modified by gene technology, or
- an organism that has inherited particular traits from an organism (the initial organism), being traits that occurred in the initial organism because of gene technology, or

- anything declared by the regulations to be a genetically modified organism, or that belongs to a class of things declared by the regulations to be genetically modified organisms.

14.4.2 SCU Microbiology Procedures

The SCU Microbiology Procedures has been developed to regulate all teaching and research proposals of work involving the use of GMOs, on behalf of the Regulator and the University to ensure that the Act, Regulations and guidelines are followed.

Laboratories where genetic manipulation work is conducted must be classified according to the physical containment levels outlined in *AS/NZS 2243.3* and be certified by OGTR.

ALL WORK INVOLVING THE USE OF GMOS MUST:

- comply with *OGTR guidelines* that provide detailed 'operating instructions' through the *Handbook on the Regulation of Gene Technology in Australia*;
- have written approval from the Head of Work Unit before commencement.

For details of application requirements, certification of physical containment facilities etc, refer to SCU Microbiology Procedures.

14.5 Quarantine Biological Material

14.5.1 Introduction

The Australian Quarantine Inspection Service (*AQIS*) administers the importation and use of biological products in order to ensure safe handling, security and disposal of such products in Australia. Their aim is to prevent or control entry, establishment or spread of pests and diseases that will or could cause significant damage to humans, animals, plants, the environment or economic activities.

14.5.2 Imported Biologicals

Imported biological materials are products containing material of human, animal, plant or microbial origin and include foods, therapeutics, laboratory materials, and vaccines.

The *importation of some biological products* is subject to certain quarantine conditions, as outlined in the AQIS Import Conditions Database. It may be necessary to obtain approval from AQIS before importing biological material (*Application to Import Biological Material*).

Low risk biologicals do not require a quarantine entry permit and include:

- human tissue (blood, serum, plasma), human genetic material and fluids,
- synthetic laboratory reagents (not derived from human, animal, plant or microbiological substances),
- organic chemicals and substances,
- non-biological buffers (e.g. Tris and EDTA),
- oligonucleotides and primers,
- synthetic culture media

High-risk biologicals do require a quarantine import permit and include:

- animal tissues, extracts and fluids;
- animal blood, serum or plasma products;
- animal serum containing antibodies;
- animal or microbiologically derived enzymes, hormones or proteins;
- genetic material (other than human);

- microorganisms;
- cell lines and any derived products (including human cell lines);
- culture media containing animal, plant, human or microbial material;
- experimental, non-released vaccines;
- human faeces of material known to be infected with a pathogenic organism.

Refer to *ICON* for current quarantine import conditions and if necessary the *AQIS checklist for importing biological materials*.

It is also necessary to keep records for imported goods that should include the following details:

- date the material was received;
- quarantine entry number;
- name of the supplier;
- import permit number;
- description of material;
- batch number;
- proposed research and analysis details;
- details of any special treatments;
- date when research or analysis was completed;
- methods and dates of disposal.

14.5.3 *In vivo* use of Imported Biologicals

It is necessary to obtain an *in vivo approval* from AQIS for the use of restricted imported biological products in non-laboratory animals (see below) and plants.

14.5.4 Quarantine Approved Premises

Facilities considered a high quarantine risk require registration with AQIS as a *Quarantine Approved Premises* (QAP). High quarantine risk activities include the production of veterinary vaccines and therapeutics, and research involving the *in vivo* *use of imported biologicals in non-laboratory animals and plants*. (See also *Guidelines for use of imported biologicals in non-laboratory animals*).

Non-laboratory animals include birds, sheep, cattle, birds, dogs, deer, horses, cats, marsupials, monotremes, pigs, camels.

Laboratory animals must be managed as laboratory animals and include amphibians, crustaceans, fish, guinea pigs, hamsters, insects, marine animals, mice, molluscs, primates, rabbits, rats, reptiles, rodents, and microorganisms. Refer also to Section 17 Laboratory Animals.

All QAP must:

- obtain from AQIS an in vivo approval to use imported biological material in non-laboratory animals and plants before the commencement of work;
- comply with AS/NZS 2243.3 - Safety in Laboratories – Microbiological aspects and containment facilities;
- ensure that all high-risk biological waste is disposed of appropriately;
- comply with the conditions and requirements of the approval.

14.6 Safe Handling of Blood, Body Fluids and Tissues (Human or Animal)

14.6.1 Introduction

There are many infectious diseases that can be transmitted by biological material of human or animal origin that are handled by laboratory personnel, including HIV, hepatitis, tuberculosis, enteric diseases and possibly SARS (severe acute respiratory syndrome).

Occupational infection may occur through a number of routes including aerosol inhalation, percutaneous absorption (e.g. cut), parenteral (e.g. injection), mucous membrane (e.g. splash to mouth), conjunctival (e.g. spray into the eye) or through non-intact skin (e.g. contamination of a cut on the hand).

Consequently, all biological material should be considered potentially infectious, regardless of HIV or HBV status, and be handled using 'Standard Precautions', as a basic risk minimisation strategy to prevent the transmission of infection. Standard Precautions are detailed in the *National Code of Practice for the Control of Work-related Exposure to Hepatitis and HIV (Blood-borne) Viruses [NOHSC:2010(2003)]*

All projects (teaching or research) using material of human origin or other biological material that is potentially infectious and/or hazardous must have the written approval of the University before work commences

14.6.2 Standard Operating Procedures (SOP)

SCU has developed a Blood Borne Pathogens Policy for Dealing with Specimens of Human Origin and/or Potentially Infectious and/or Hazardous Agents. These procedures incorporate Standard Precautions and **must** be followed when working with or handling any of these materials.

14.7 Special Equipment

Procedures that have a high potential for the production of infectious droplets or aerosols should be performed in suitable containment equipment, such as biological safety cabinets (See Section 18.4, and/or Section 18.5). This may include blending, vigorous mixing, sonication, harvesting of cells or tissue, etc.

14.8 Disposal of Waste

Laboratories that generate biological waste must segregate and dispose of this potentially hazardous and infectious waste in accordance with EPA requirements as detailed in Section 16.6 Disposal of Clinical and Biological Waste.

Legislation covering the requirements for the Disposal of Clinical and Biological Waste mandates that certain hazardous and infectious biological waste must be rendered safe before disposal i.e. before it leaves the laboratory. Autoclaving is the accepted method used by the University for the de-contamination of microbiological waste prior to disposal. See Section 18.3 Autoclaves for more information about autoclaving.

14.9 Biological Spills

Biological spills are spills that contain potentially pathogenic microorganisms and/or other biohazardous materials such as specimens of human origin (e.g. blood, tissues), and/or other potentially infectious or hazardous biological material (e.g. animal blood or tissues).

As with all laboratory spills biological spills must be dealt with immediately to minimise the risk of infection and contamination. Refer to Section 5.8.7 Biological Spills.

14.10 References

AS/NZS 2243.3:(2002) – Safety in Laboratories – Microbiological Aspects and containment facilities
AQIS
AQIS checklist for importing biological materials
AQIS guide to importing biological products
AQIS in vivo approval for use of imported biologicals
AQIS Quarantine Approved Premises
Gene Technology Act 2000
Gene Technology Regulations 2002
Handbook on the Regulation of Gene Technology in Australia
ICON (AQIS Import Conditions Database)
National Code of Practice for the Control of Work-related Exposure to Hepatitis and HIV (Blood-borne) Viruses [NOHSC:2010(2003)]
OGTR guidelines
SCU Health and Safety Procedures for Working with Microorganisms
SCU Blood Borne Pathogens Policy

15 Radiation Safety

All matters relating to Radiation Safety at SCU have been covered in the Radiation Safety Manual.

16 Disposal of Laboratory Wastes

16.1 Introduction

Waste management procedures must be adopted by SCU waste generators to protect the health and safety of persons in control of, or exposed to hazardous waste in the workplace, and the community in general. The appropriate control measures adopted should be environmentally responsible and comply with relevant Federal and State legislation and any other regulatory requirements.
The procedures in place should minimise the amount of laboratory waste generated in the first instance by implementing waste minimization strategies. This is outlined in the following hierarchy for managing waste, from most desirable to least desirable, and meets the objectives of the *NSW Waste Avoidance and Resource Recovery Act 2001*:

- avoid unnecessary resource consumption (e.g. reduce quantities purchased, reduce scale of experiments)
- recover resources (including reuse, reprocessing, recycling, transfer and exchange, energy recovery)
- dispose (as a last resort).

Generators of laboratory waste should be made aware of the great difficulty and/or expense associated with the disposal of some types of wastes (e.g. heavy metals, chlorinated solvents, long half-life radioactive isotopes).

Laboratory waste disposal procedures should clearly outline:

- who is responsible
- training requirements including contract cleaners
- the categories into which waste is to be sorted or segregated
- the temporary facilities for waste storage
- the collection schedule and
- the final disposal arrangements with a NSW Environment Protection Authority (EPA) approved waste disposal contractor
- records of disposal of waste in accordance with health and government requirements

The initial segregation and disposal of waste into approved waste disposal containers or bags, must be conducted in the area where the waste is generated.

All personnel handling bagged laboratory wastes must

- not compress bags
- not place hands inside the bag
- not hold bags close to their body
- not hold bags by the base

16.2 Waste Tracking Requirements

Under the Protection of the Environment Operations Act 1997, waste tracking requirements apply to certain types of waste. They are subject to special monitoring and reporting requirements of the Environment Protection Authority (EPA). These waste tracking requirements apply throughout NSW to the consignment, transportation and acceptance for storage, treatment or disposal of certain types of waste.

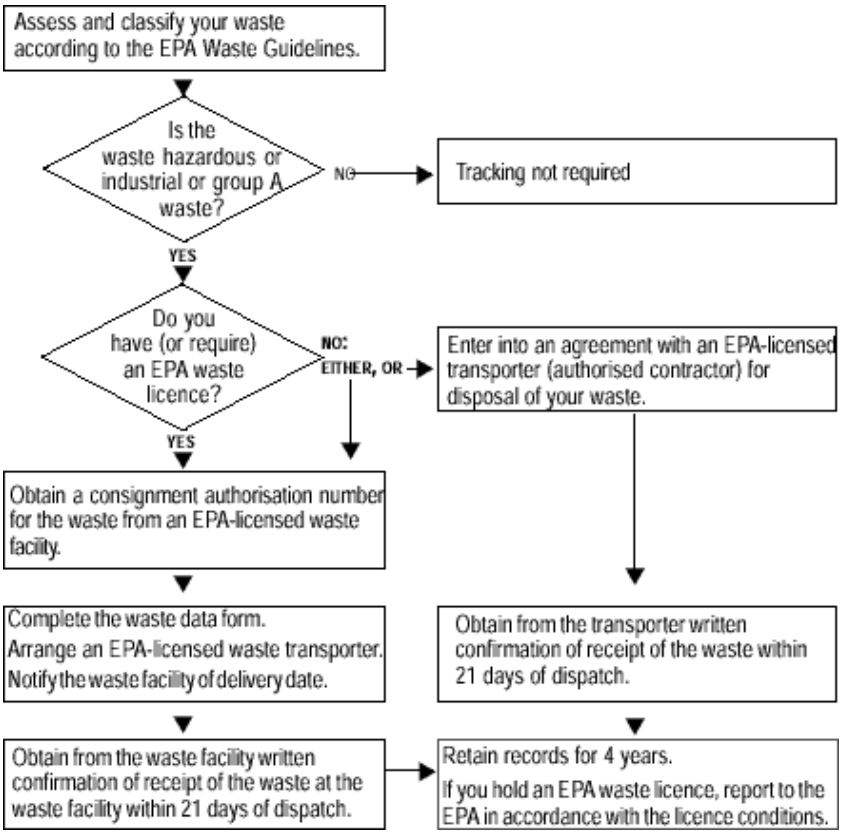
Under the POEO Act and the EPA's *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes*, wastes classified as **hazardous** (liquid and non-liquid), industrial, or group A liquid wastes (non-aqueous liquid waste and controlled aqueous liquid waste)

are subject to special monitoring and reporting requirements by the EPA under the waste tracking system.

Hazardous liquid wastes include, various laboratory chemicals (solvents, organics, acids and bases, pesticides, herbicides), radionuclides, pharmaceuticals, poisons.

Hazardous non-liquid wastes include clinical or biological waste (specimens and samples of human or animal origin, micro-organisms, sharps) that has the potential to cause injury, infection or offence.

Main steps in waste tracking (from EPA)



16.3 Responsibility for Hazardous Waste

Person(s) in control of a workplace/area where hazardous wastes are generated are responsible for ensuring that:

- staff are fully aware of and adequately trained in waste management procedures and there are Safe Work Procedures in place;
- materials and procedures are in place for containing wastes and cleaning up spills;
- waste is kept to a minimum by adopting good work practices and purchasing materials that will reduce waste production;
- adequate resources are available for waste management procedures;
- unwanted or used substances are suitably disposed of or transferred to other areas with higher usage;
- all relevant licences and permits required by statutory authorities for discharge and disposal of waste are current;
- each area maintains a record of waste products, including details of quantities and identification of waste generated, analysis of unknowns and verification of disposal;
- if a specialist contractor is utilised to pick up and dispose of hazardous waste, the selected contractor should:
    - be fully licensed to transport and dispose of the category of waste by the relevant authority (refer to EPA regulations);

- supply written confirmation of the final disposal of the hazardous waste.

16.4 Segregation of Laboratory Waste

Many different types of wastes are generated in laboratories and associated facilities. Each category of waste (such as chemical, biological, clinical or sharps and radioactive waste) requires segregation prior to storage and disposal.

Laboratory wastes should be at least sorted into the following categories as outlined in *AS/NZS 2243.1*:

- non-contaminated paper and plastics may be collected in a single layer plastic bag and disposed of as general waste see AS/NZS 2243.3 ;
- broken glass, into a container specifically designed for that purpose and labelled accordingly. Refer also to Section 10.9 Handling and Disposal of Sharps.
- If broken glass is contaminated refer to Section 10.9.2 Broken Glass (clean and contaminated) ;
- sharps see AS/NZS 2243.3 and AS 4031 ;
- chemical see AS/NZS2243.2 ;
- clinical and biological waste (see Section 16.5 below and AS/NZS 2243.3);
- cytotoxic;
- animal carcasses (see AS/NZS 2243.3 and AS/NZS 2243.4);
- radioactive (see AS/NZS 2243.4);
- drugs of addiction (refer to National and/or State guidelines).

16.5 Chemical and Solvent Waste

16.5.1 Introduction

Chemical waste management procedures should include guidelines for the treatment, packing and segregation of chemical and solvent waste.

16.5.2 Treatment of Chemical Waste

Prior to disposal chemical treatment procedures should be considered and include:

- neutralization of acid solutions;
- neutralization of alkaline solutions;
- reduction of oxidising agents;
- oxidation of reducing agents.

16.5.3 Segregation of Chemical Waste

The following chemical and solvent wastes should be segregated prior to disposal:

- halogenated solvents (e.g. chloroform, carbon tetrachloride);
- non-halogenated solvents (e.g. xylene, methanol, acetone, toluene);
- mineral acids (e.g. hydrochloric, perchloric, sulfuric);
- organic acids (e.g. acetic, trichloroacetic);
- bases (e.g. sodium hydroxide, photographic developer);
- oxidising agents (e.g. sodium nitrate, organic peroxides, potassium permanganate);
- heavy metals (e.g. arsenic, lead, silver, mercury, chromium);
- poisons (e.g. cyanides, sulfides);
- water-reactive materials (e.g. sodium, potassium);
- carcinogens (e.g. polycyclic hydrocarbons, aromatic amines, nitrosamines);

- cytotoxic drugs.

16.5.4 Segregation of Carcinogenic and Cyanide Waste

Carcinogens, cyanide compounds and other highly toxic chemicals must be packaged separately, placed in a secondary leak-proof container and specifically labelled prior to disposal.

16.5.5 General Procedures for Chemical Waste Storage and Disposal

The following general procedures apply for chemical and solvent waste:

- Liquid Waste Storage: Liquid wastes such as solvents, organics or acids are to be stored in containers approved by the statutory authority. The container should be:
- resistant to the chemical contents,
- able to be sealed,
- suitable for transport,
- not more than 20 litres capacity. Commonly, 15 L Australian Dangerous Goods approved plastic drums are used at SCU.
- Solid Waste Storage: Solid waste and small quantities of hazardous liquid waste should be stored in their original containers prior to disposal.
- Labelling of Waste Containers: Waste containers must be clearly labelled with the:
    - nature of contents,
    - date,
    - name of the person responsible for the waste,
    - the School/Department/Unit generating the waste,
    - quantity disposed of.
- Compatibility: Only compatible substances should be packed in the same container.
- Segregation of waste containers: When storing hazardous waste containers they should be segregated if necessary and stored in accordance with statutory requirements.

16.6 Clinical and Biological Waste

Clinical and biological waste has the potential to cause injury, infection or public offence. Clinical and biological wastes fall into the non-liquid wastes category and must be disposed of at the point of generation.

Clinical and biological waste includes:

- specimens or samples of human origin (e.g. blood, body fluids, tissues and other clinical samples, swabs, bandages, wound dressings etc);
- animal waste (e.g. animal tissue and remains, carcasses, bedding and other materials from infected animals etc);
- microbiological waste (e.g. petri-dish and other micro-organism cultures, cell culture materials etc);
- cytotoxic, pharmaceutical, recombinant DNA waste and quarantine waste from imported biological material;
- sharps waste (e.g. needles, syringes, scalpels, lancets, contaminated broken glass);
- radioactive waste (refer to SCU Radiation Safety Manual).

A local waste management plan for the disposal of clinical and biological waste should be developed in accordance with *AS/NZS 2243.3 (2002)* (Section 9), *Waste Management Guidelines for Health Care Facilities*. Standard operating procedures should include Safe Work Procedures for waste handling and segregation, spills management, training of staff and regular review and update of waste management plan.

All clinical and biological wastes should be classified as **contaminated** (i.e. infectious or with the potential to cause infection or disease) and treated as follows:

- most clinical and related wastes can be decontaminated by autoclaving. Care must be taken to exclude body parts, pharmaceuticals, cytotoxics, and radioactive wastes;
- incineration should be used for disposal of recognisable body parts and pharmaceuticals including toxins;
- all contaminated wastes should be placed into suitable containers or bags that display the biohazard symbol, are leak-proof, able to be sealed and if necessary autoclaved and segregated from other wastes;
- contaminated waste bags must have sufficient strength to safely contain the waste class they are designated to hold and not be filled to more than two-thirds of their capacity or 6 kg whichever is the lesser;
- double-bagging of contaminated waste is recommended so as to minimise the potential for breakage and spills of the contents;
- contaminated waste containers or bags should be identified with the international biohazard symbol, be colour-coded and identified according to the national standard *AS/NZS 3816:1998 Management of Clinical and Related Waste* with name of person responsible for the waste and the School/Department/Centre generating the waste clearly displayed;
- wastes containing live micro-organisms should be autoclaved or treated with an appropriate disinfectant before disposal;
- microbiological waste should be autoclaved before leaving the laboratory;
- clinical wastes should be autoclaved, treated by chemical disinfection, or incinerated. If solid waste is autoclaved or treated chemically, it may be reclassified as 'non-hazardous' and disposed of by incineration or landfill;
- cytotoxic waste must be destroyed by incineration;
- when disposing of sharps, safe work practices require the minimum amount of handling;
- immediately after use, sharps should be placed in a dedicated, secure sharps container which is clearly labelled for this purpose and which complies with AS 4031;
- disposable needles should not be recapped or bent and disposable needle/syringe sets should be discarded as a single unit into an approved sharps container;
- sharps containers once filled, should be sealed and placed into suitable contaminated waste bags for disposal. They must not be emptied or reused under any circumstances;
- in most laboratories, broken glass is usually contaminated with either chemical or biological products. If broken glass cannot be decontaminated, it should be disposed of in suitable containers that are large enough to hold broken glassware, are rigid, impenetrable, and able to be sealed and clearly labelled. Any other labeling should refer to the contamination See Section 10.9 Handling and Disposal of Sharps;
- all contaminated waste containers/bags should be placed into dedicated rigid-walled storage bins (e.g. 'otto' bins) that are hygienic, able to contain spills, lockable and labelled for such storage. These bins are usually supplied by a licensed waste disposal contractor, authorised by the EPA;
- contaminated waste storage bins should be held in a suitably sited and sign-posted area that is kept secure at all times, prior to collection by the approved waste disposal contactor;
- all solid contaminated waste should be collected and disposed of by high temperature incineration by the authorised contactor;
- appropriate records of waste disposal must be kept by the waste generator for a period of at least three years as follows:
    - name, address and license number of the authorised contractor;
    - copy of agreement for waste disposal;
    - accurate identity of waste type and advice to authorised contractor of details for each load;
    - date of collection;
    - receipt of waste disposal or incineration from the authorised contractor for each load.

16.7 Radiation Waste

Refer to the Radiation Safety Manual.

16.8 Mixed Waste

The following strategies should be considered when dealing with mixed wastes:

- endeavor to minimise the production of mixed wastes;
- assess the risks associated with the hazards;
- minimise the hazard – e.g. use water-based chemicals instead of solvent-based chemicals;
- choose an appropriate disposal option, and if possible a single option (e.g. incineration);
- identify multiple statutory requirements;
- ensure that laboratory staff are adequately trained in waste management.

Treatment and disposal of mixed waste must ensure that all hazards are appropriately addressed.

16.9 References

AS 4031:1992 - Non-reusable containers for the collection of sharp medical items used in health care areas
AS/NZS 2243.1:2005 - Safety in laboratories – Planning and operational aspects
AS/NZS 2243.2:1997 - Safety in laboratories – Chemical aspects
AS/NZS 2243.3:2002 - Safety in laboratories – Microbiological aspects and containment facilities
AS/NZS 2243.4:1998 - Safety in laboratories – Ionizing radiations
AS/NZS 3816:1998 - Management of Clinical and Related Waste
NSW EPA Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes
NSW EPA Protection of the Environment Operations Act 1997
NSW Health - Waste Management Guidelines for Health Care Facilities (1998)
NSW Waste Avoidance and Resource Recovery Act 2001

17 Laboratory Animals

17.1 Introduction

The use of animals or animal tissues for educational and research purposes is regulated in Australia by State Government legislation that incorporates the *Australian Code for the Care and use of animals for Scientific Purposes (8th Edition, 2013:NHMRC)* (the Code).

17.2 Use of Laboratory Animals at SCU

At SCU all research or teaching proposals involving the use of animals must have the approval of the SCU Animal Care and Ethics Committee (ACEC) before it can proceed. Refer to the SCU ACEC for application forms, training resources, legislative requirements, etc.

As a general principle the ACEC accepts the use of animals in research and teaching providing there is:

- a demonstrated educational or research benefit
- no suitable alternatives available at the time e.g. video, computer simulation
- a minimum number of animals used
- a demonstrated effort to minimise the likely impact on the welfare of the animals used.

Research and Teaching activities must also be compliant with these legislative and internal requirements:

- Management and prevention of adverse events and hygienic practice within laboratory settings to follow responsibilities as aligned with the Code.
- Any adverse events or events requiring welfare must be immediately reported to the Animal Ethics Office and the Animal Care and Ethics Committee, through which a veterinarian can provide advice on how this can be managed in an ethical and humane manner.
- All researchers handling animals are responsible for their humane treatment and husbandry, and required to demonstrate competency through a checklist at time of animal ethics application. Competencies are ensured and documented by the Animal Ethics Office and assessed by the Animal Care and Ethics Committee. All researchers have a responsibility to ensure their competencies are up to date and comply with the Code.
- Researchers should refer to the chemical (section 13) and biological safety (section 14) sections of the laboratory safety manual for managing chemicals and biological safety. Moreover, researchers should refer to Section 2 on Responsibilities and Section 3 on Animal Wellbeing of the Code to ensure all husbandry is undertaken humanely. For specific procedures on the wellbeing of animals to be followed, researchers to refer to Section 3.3 on Specific Procedures for supporting animal wellbeing.
- With regard to Humane Killing, researchers to refer to Sections 3.3.45 and 3.3.46 of the Code to ensure ethical practice.
- If advice is required, should there be further queries or concerns regarding use of chemicals or animal husbandry, queries to be forwarded to the Animal Ethics Office.

The ACEC endorses the ethical guidelines developed by the Australian and New Zealand Council for the Care of Animals in Research and Teaching (*ANZCCART*), and encourages that these guidelines be made available to students in the University who may use animals or animal tissues in their studies. Refer to "Ethical guidelines for students using animals or animal tissues for educational purposes" below.

The following related documents are available on the SCU ACEC Downloads site:

- SCU Animal Care and Ethics Committee Members
- Animal Care and Ethics Committee Procedures / Terms of Reference
- Animal Ethics Research Application Form

- Animal Ethics Committee Meeting Dates
- SCU ACEC Renewal
- ACEC Change of Protocol

Animal Research Authority Application Guidelines

17.3 References

Animal Research Act 1985
ANZCCART (Australian and New Zealand Council for the Care of Animals in Research and Teaching)
ANZCCART Ethical guidelines for students using animals and animal tissues for educational purposes
AS/NZS 2243.3:2010 - section 6 Animals animal containment facilities
NHMRC Australian Code for the Care and Use of Animals for Scientific Purposes (2013)
SCU ACEC Downloads

18 Plant and Engineering

18.1 General Equipment

All general equipment falls within the definition of plant and equipment and as such is subject to SCU policies and procedures for purchasing, installation, training, maintenance and risk assessment.

SafeWork NSW provides general advice relating to the use of plant in the workplace this can be found in the publication on Plant.

There are certain types of plant and equipment that are specific to laboratory environments and as such require more stringent levels of operation and management. Such plant and equipment in use at the University is considered in the following sections.

18.2 Fume Cupboards

18.2.1 Introduction

Fume cupboards are a safety device used within a laboratory to ensure that persons are not exposed to toxic fumes during experimentation and/or while other related work such as decanting is undertaken.

Fume cupboards should be used for all operations that have the potential to generate fumes, mists or dusts of a hazardous nature. Work involving microorganisms, specimens of human and animal origin, and recombinant DNA should not be carried out in fume cupboards. This type of work should be done in a biological safety cabinet, refer to Section 18.4 Biosafety Cabinets.

The purpose of the fume cupboard is to capture, dilute and ultimately discharge fumes in a safe manner to the outside atmosphere. Air that has been extracted from fume cupboards should not be recirculated to any other rooms.

The serviceability, reliability and performance of fume cupboards is regarded as critical to ensuring effective hazard management within a laboratory.

Fume cupboards are classified as hazardous areas (see *AS 2430.3.6:2004*) and must be designed and located according to *AS/NZS 2243.8:2001 Safety in Laboratories – Fume Cupboards*: Section 2.10.

18.2.2 Design and Location

Summary of Design Requirements:

- materials used in the construction of fume cupboards are to be resistant to the substances being used, easy to clean and have a smooth finish to allow for safe manual washing of the interior;
- services within the fume cupboard such as gas, electricity and water, should be positioned appropriately to minimize the risk of fire or explosion;
- emergency isolation switches for gas and electrical power should be appropriately labelled and adequately identified;
- power supply to the fume cupboard exhaust system should not be interrupted in the event of emergency power isolation, but be separate and visually and audibly alarmed in the event of failure;
- lighting within the fume cupboards should give adequate illumination of the work area;
- a warning label located on the fume cupboard should specify the maximum spill containment volume of each unit, with a direction for activation of the emergency isolation switch in the event of a spill;

- fume cupboards should have a unique identification label which includes the manufacturer's details, model number and any special features incorporated in the design (e.g. scrubbers for perchloric acid use).

18.2.3 Maintenance and Testing

All fume cupboards, including the ductwork and exhaust stacks, should be regularly inspected and a regular maintenance program should be in place, in accordance with the manufacturer's recommendations, statutory requirements and relevant standards.

The University, through Facilities Management and Services, engages a licensed contractor for programmed preventative maintenance, performance testing and servicing, and breakdown maintenance of all fume cupboards throughout SCU.

All performance tests and measurements relating to the performance characteristics of fume cupboards will be carried out in accordance with the *AS 2243.8*, Appendix B.

Prior to any maintenance of fume cupboards, the laboratory supervisor must ensure that all equipment, hazardous materials and chemicals are removed from the fume cupboard.

The laboratory supervisor should ensure that contractors who are required to access a laboratory area to perform maintenance or service work are made aware of the hazardous nature of materials and equipment contained within that area, as well as the necessary emergency and decontamination procedures.

During maintenance the fume cupboard should be tagged as follows:

'System under maintenance – Do Not Use'.

After completion of fume cupboard testing for compliance with the relevant standards by the contractor, a self-adhesive label should be attached indicating the inspection date, name of inspector and report number, overall test result (pass or fail) and the date the next inspection is due.

18.2.4 Guidelines Covering Effective Operation

To ensure that fume cupboards provide and maintain the highest level of hazard control the following guidelines shall apply:

- substances that are highly toxic, volatile, corrosive, flammable, explosive, odiferous, chemically active or noxious must be used in fume cupboards;
- fume cupboards must not be used as storage facilities for hazardous chemicals or experimental equipment;
- excess materials used in the fume cupboard during experimental work may interfere with airflow and compromise the efficiency of operation of the fume cupboard;
- materials and equipment should be kept to a minimum and positioned at the back of the fume cupboard to reduce disturbance to airflow. If large amounts of equipment is to be used in fume cupboards, then it should be placed on a platform that has a 2-5cm clearance from the bench surface to allow for balanced airflow and fume containment;
- when using the fume cupboard, the sash should be lowered as far as practicable to improve fume containment;
- drafts from windows and doors and other room air turbulence (e.g. fans) can affect the performance of the fume cupboard and should therefore be reduced in order to minimise the risk of exposing the user to contaminants;
- only solid laboratory apparatus or equipment may be stored under fume cupboards;
- after completion of experiment/work all materials and equipment should be cleaned and removed, and the fume cupboard should be cleaned and decontaminated.

18.2.5 Fume Cupboards for Use with Perchloric Acid

Perchloric acid reacts with a wide variety of organic materials and the resultant compounds may detonate violently without warning. Any work using perchloric acid should only be carried out in a suitably designed fume cupboard.

Fume cupboard design and use should:

- include wash-down facilities to prevent build-up of dust deposits that may react with perchloric acid. On completion of the operation with perchloric acid this facility must be operated for 15 minutes;
- allow for any condensate, spills or dust deposits to be manually washed from the interior of the fume cupboard with a hand-held gentle spray of cold water;
- ensure that construction materials of the fume cupboard and the immediate adjacent areas are chemically resistant to perchloric acid;
- ensure the fume-scrubbing facility be run continuously during operations using perchloric acid.

18.2.6 Fume Cupboards for Use with Hydrofluoric Acid

Many of the main features of fume cupboard construction required for perchloric acid as set out in *AS/NZS 2243.8:2001* also apply for hydrofluoric acid except that its hazard arises more from dermal exposure (skin contamination) than from explosion.

Additional requirements include:

- the interior shall be crevice-free with smooth surfaces for easy decontamination;
- a hand-held shower on a flexible hose is very useful for washing down the interior surfaces of the fume cupboard;
- hydrofluoric acid etches glass and ceramics so this needs to be considered when selecting the fume cupboard sash material.

The use of hydrofluoric acid may be fatal if dermal exposure occurs. It must be removed immediately by flushing with a safety shower at full pressure, neutralized with calcium gluconate gel and the affected person taken promptly to a hospital accident and emergency department. Injections of sterile calcium gluconate under the skin into the affected tissues are usually necessary.

Hydrofluoric acid shall not be used unless there is appropriate **safety information** displayed nearby and calcium gluconate gel (in current date) immediately available within easy reach of the work area.

18.2.7 Risk Assessment for Use of Fume Cupboards

All fume cupboards used in the University should have a spillage containment volume stated on the warning label affixed to the fume cupboard. The warning label provides the **limits** for the volume of liquids to be allowed in the fume cupboard at any one time. This is not the maximum volume of liquids to be allowed in the fume cupboard at any one time. This should be determined by the Risk Assessment process.
Factors to be considered in the Risk Assessment process before determining the maximum volume of liquids allowed in the fume cupboard for use at any one time include:

- spillage containment volume of the fume cupboard (designated on fume cupboard warning label);
- type of liquids, and their properties, being used;
- volumes of each type of liquid being used;
- processes to be used e.g. heating, distillation etc;
- likelihood of a spill;
- the potential of reactions between spills and other chemicals in the fume cupboard;

- the risk to the operator if the spill is not contained within the fume cupboard/

The volume of **flammable liquids** to be used in a fume cupboard should be assessed in relation to:

- physicochemical properties such as flashpoint, volatility and boiling point;
- the processes to be used, e.g. heating, mixing methods which may cause aerosols or increased vapour, distillation or evaporation; and
- risk of spread of fire or flame if a container or a spill ignites.

For some flammable liquids the volume which may cause explosion or fire is quite small, e.g. millilitres, whereas others may be regarded as not requiring a limit using the risk assessment process above.

In accordance with *AS/NZS 2243.8:2001*, the maximum volume of flammable liquid that may be placed in a fume cupboard at any one time for use should be 7.5 L/m^2 of bunded base area.

18.3 Autoclaves and other Pressure Equipment

18.3.1 Introduction

Autoclaves, also known as 'steam-under-pressure sterilizers', are **pressure vessels** that fall under the definition of **pressure equipment**. They are usually located in biological science laboratories and are used for sterilization of media and equipment required for the culture of microorganisms, and/or the decontamination of discarded cultures, or biological, clinical or GMO waste materials. Other types of pressure vessels that may be used in the University include reactors, digesters, pressurized storage vessels, process vessels and pressurized sterilizers.

Pressure equipment also includes pressure piping and boilers (e.g. water-tube, electric and hot water heaters, fired pressure cookers etc). Pressure equipment in this section does not include gas cylinders (refer to *AS 2030* and Section 11 Gas Cylinders)

Almost all pressure equipment is hazardous, i.e. has the potential to cause harm, injury or illness, or damage to plant, property and the environment. Therefore all work involving the use of high pressure equipment is also potentially hazardous due to the risks associated with the generation of high levels of pressure and high temperatures during operation.

Serious accidents may occur if this type of plant or equipment is not designed, constructed, operated and maintained in accordance with strict codes and standards administered by the relevant Statutory Authority. The following Australian Standards give minimum requirements and guidance on the design, manufacture, examination, testing, safe operation, inspection, maintenance, repair and disposal of pressure equipment:

AS 1210 (1997)	*Pressure vessels*
AS 1228 (1997)	*Pressure equipment – Boilers*
AS 4458 (1997)	*Pressure equipment – Manufacture*
AS 4037 (1999)	*Pressure equipment – Examination and Testing*
AS 3873 (2001)	*Pressure equipment – Operation and Maintenance*
AS 4343 (2005)	*Pressure equipment – Hazard Levels*
AS 2192 (2002)	*Sterilizers – Steam – Downward-displacement*
AS 2182 (1998)	*Sterilizers – Steam – Bench-top*
AS 2593 (2004)	*Boilers – Safety management and supervision systems*
AS/NZS 1200 (2000)	*Pressure equipment*
AS/NZS 3788 (2001)	*Pressure equipment – In-service inspection*
AS/NZS 3892 (2001)	*Pressure equipment – Installation*
AS/NZS 2243.6(1990)	*Safety in laboratories: Mechanical aspects*
AS/NZS 2243.3(2002)	*Safety in laboratories: Microbiological aspects and containment facilities*

18.3.2 Safe Use of Pressure Equipment

Safe Working Procedures (SWP) should be developed by Work Units to manage the use and operation of pressure equipment. Suitable work practices should be implemented and periodically reviewed, and operation and maintenance procedures audited for legislative compliance.

All persons involved in the use or operation of pressure equipment must be trained prior to its use. Training should include awareness of the hazards associated with high pressures and temperatures, safe operating procedures, emergency procedures, and the appropriate control measures required to ensure protection of personnel, equipment and the environment.

Safety requirements for the use of high pressure equipment are specified in *AS 2243.6* as follows:

- only materials and equipment designed to withstand high pressures shall be used in its manufacture;
- if equipment includes a boiler (e.g. steam autoclaves), then the boiler shall have fitted an appropriate safety valve, water level alarm and fusible plug (in conjunction with a temperature gauge);
- safety valves and other methods of pressure release, and remote methods of power cut-off, shall be sited so that their operation cannot injure people or damage equipment;
- safety valves incorporating a means of manual release shall be operated regularly, to ensure correct operation. They shall not be adjusted by unauthorized persons and, where provision is made for locking, shall be kept locked;
- regular inspection and certification of pressure vessels by an independent inspector is mandatory, as specified in AS 2243.6;
- if glass apparatus is to be pressurized, it shall be screened, and full-face protection shall be worn by the operator.

18.3.3 Legal Obligations

There are a number of legislative requirements that must be met for the safe management of pressure equipment used within laboratories at SCU:

- periodic in-service inspection and certification of boilers and pressure vessels must be conducted by an independent and accredited inspector who is external to that of the organisation or the manufacturer. This will assist in assuring safe operation until the next scheduled inspection;
- Inspection periods are detailed in Table 4.1 of *AS/NZS 3788*. Steam pressure vessels (e.g. autoclaves) require inspection every 2 years.
- The inspector must issue a signed certificate or report of inspection to the owner for required record keeping.
- A competent member of staff should be nominated to organize and oversee a suitable maintenance and inspection program for pressure equipment in their designated area, as outlined below:
    - arrange for the regular (periodic and annual) maintenance of pressure equipment by an authorized manufacturer (or their nominated person) with appropriate experience in the design and manufacture of the pressure equipment and its safety systems;
    - arrange for periodic in-service inspections of boilers or pressure vessels, by an accredited inspector, in accordance with the manufacturer's recommendations and other requirements necessary for the safe and secure operation of the equipment;
    - arrange for regular checking, testing and maintenance of boilers as specified in AS 2593;
    - ensure that appropriate measures are provided to prevent, as far as practicable, unauthorized persons from interfering with pressure equipment and its controls;
    - ensure that incidents, damages, faults or defects with pressure equipment are reported, recorded and rectified;

- notify the in-service inspector of incidents or changes that could affect the integrity of the pressure equipment;
- ensure that records of in-service inspection, certification, in-house testing, maintenance, repair and operation activities are maintained and easily accessible (e.g. in a logbook) and be available for review by a certified inspector or regulatory authority;
- supervise the general safety of pressure equipment to ensure that it is operated in a safe manner and without risk to the health and safety of staff, students and others in accordance with the WHS Act 2011.

Risk Assessments shall be performed in order to:

- Identify hazards which could arise from the interaction of individual pressure equipment with other equipment in the facility, and events that could result in personnel injury or damage to plant or the environment (e.g. potential for equipment rupture leading to risk of blast and projectiles, loss of containment leading to risk of infection, suffocation, fire, explosion or burns);
- Assess the risks to personnel, property and the environment that could result;
- Implement appropriate controls to reduce the risks to the lowest practicable level;
- Review operational and maintenance procedures, and risk assessments on a regular basis and record the reviews.

Appropriate emergency procedures must be in place to deal with accidents/incidents involving pressure equipment e.g. emergency evacuation, communication/signage in the event of equipment failure, fire extinguishers and any other apparatus or measures that are identified in the risk assessment.

All person(s) operating pressure equipment must be adequately trained, provided with appropriate safety information, and supervised to the extent necessary to ensure their health and safety when using pressure equipment. Records of training must be kept and be readily accessible.

18.3.4. Autoclaves for use in Biological/Microbiological Laboratories:

In addition to the requirements above, the following requirements are also applicable to steam sterilizers (autoclaves) as per *AS 2243.3*.

- persons using an autoclave shall be appropriately trained, and understand the need to ensure that proper conditions for load sterilization are selected and produced in the chamber;
- operators must be provided with and use appropriate personal protective equipment;
- personal protective equipment should include the use of heat insulating gloves of sufficient length when loading and unloading the autoclave, and the use of a face shield to protect the face from steam that may be present, especially when unloading;
- a separate storage area for infectious or contaminated waste should be provided away from ‘clean’ or sterilized/decontaminated items. Wastes are to be stored in suitable impermeable plastic bags (contaminated waste bags or ‘autoclavable’ bags) or lidded containers;
- wire racks or metal shelving should be provided in the vicinity of the autoclave for the cooling of autoclaved loads;
- trolleys should be provided for the loading and unloading of large or heavy loads with sufficient space to allow for their movement;
- sufficient penetration time should be allowed for all parts of the load to reach the appropriate temperature i.e. 15 minutes at 121oC or 4 minutes at 134oC;
- during normal operation, the autoclave cycle should always be completed before opening the door;
- prior to removal of the load, the autoclave door should be partly opened and sufficient time allowed for the load to cool down before handling;

- extreme care should be taken when removing containers of fluids from the autoclave – ensure the required amount of cool-down time has elapsed before removing;
- **flammable materials, including samples containing solvents, must not be autoclaved**;
- appropriate chemical disinfectants should be available for spills or leaks;
- Hand washing facilities, safety showers and eyewash facilities should be provided and be easily accessible;
- biological indicators, such as spore strips, should be used at regular intervals to monitor the microbiological killing power of the sterilization process. Visual indicators such as autoclave tape will only give an indication that the sterilizer load has been processed at the desired temperature, but do not monitor the efficacy of the sterilization procedure;
- where an autoclave is used in a PC2 lab or for the decontamination of GMO contaminated material, it must be tested for 'effectiveness of decontamination' at least every month as required by OGTR. The results and date of the tests must be posted on or adjacent to the autoclave;
- a logbook for recording details of the load and cycle should be maintained, and chart records kept for regular checking by staff and qualified service personnel, so that the autoclave is maintained within the calibration specifications.

18.4 Biosafety Cabinets

18.4.1 Introduction

Biological safety (biosafety) cabinets are a type of special containment equipment designed to protect laboratory personnel and others from the risk of exposure to biological hazards and contamination posed by the generation of aerosols that may be produced during common laboratory operations.

Surveys on the causes of laboratory-acquired infections indicate that 80% of laboratory infections result from exposure to aerosols that are produced by common procedures such as pipetting, blending and homogenizing.

Therefore the objectives for the control of these hazards are to minimize the potential for exposure of personnel to these hazards and to prevent the liberation of micro-organisms or biohazardous material from the laboratory into the environment. The control of such hazards is known as '*containment*', meaning that they are kept within specified limits, and *primary containment* is provided by the use of good microbiological techniques and by the use of appropriate safety equipment.

The biosafety cabinet is the principal device for the containment of aerosols and as such forms the **primary barrier** of control. Other barriers are as follows:

- Secondary barriers: provide containment in the event of failure of the primary barrier. Example of a secondary barrier is the room (and its support facilities) within which the primary barrier is located;
- Tertiary barriers: are usually buildings in which the secondary barriers are housed;
- Quaternary barriers: are the geographical sites of buildings constituting the tertiary barriers.

Laminar flow clean-air benches are not containment devices and should not be used for handling micro-organisms or other hazardous biological materials. They are designed as clean workstations, providing HEPA filtered air to protect the work area **only**, in a vertical (downflow) direction or in a horizontal (crossflow) direction. Any aerosol produced from work is discharged towards the operator and into the environment.

18.4.2. Classes of Biosafety Cabinets

Biosafety cabinets are divided into three classes depending on the method of construction providing the containment and the level of containment provided.

Their selection and use is dependent on the risk group of micro-organisms to be used (refer to Section 14.3.2), level of containment required (refer to Section 14.3.3) and the type of work being conducted (e.g. handling infectious material).

Class I biosafety cabinets are less common and less complex in design. They are designed to provide an inward flow of air away from the operator, with the exhausted air being passed through a HEPA filter before being discharged externally. This provides for operator protection and the protection of the environment, but not for product protection. For additional information refer to *AS2252.1 - Biological safety cabinets (Class I) for personnel and environment protection.*

Class II biosafety cabinets have a barrier air flow to protect the operator, and in addition, a laminar flow of HEPA filtered air over the work area to protect the product against contamination. Exhausted air is passed through an additional HEPA filter before being discharged. For additional information refer to *AS2252.2 - Laminar flow biological safety cabinets (Class II) for personnel, environment and product protection.*

Both Class I and Class II cabinets are partially open-fronted and provide a degree of protection against micro-organisms of Risk Groups 2 and 3, where the work may produce significant amounts of aerosols. They are also required for GMO work where various levels of containment are described for both small-scale and large-scale operations (refer to Section 14.4).

Class III biosafety cabinets are totally enclosed devices where the user works through built-in gloves. They provide a high degree of containment for personnel and the environment against the high-risk micro-organisms of Risk groups 3 and 4, as well as a high degree of product protection.

Cytotoxic Drug Safety Cabinets are not currently used at SCU and will not be covered in this section. For further details of 'Laminar Flow Cytotoxic Drug Safety Cabinets' refer to *AS 2567*, *AS 2639,* and *AS 4273*.

Class I and Class II biosafety cabinets are unsuitable for handling cytotoxic drugs.

18.4.3. General Requirements for Installation and Use of Biosafety Cabinets

AS/NZS 2647 sets out requirements and recommended practices for the installation, operation, decontamination, maintenance and inspection of Class I and II biosafety cabinets specified above. These are summarized as follows:

- Selection of Class of Cabinet
  Selection of the class of cabinet shall take into account the requirements for either personnel protection or personnel and product protection.
- Quaternary Barrier: The Site
  Siting of the cabinet shall be appropriate to the agents/biohazardous materials being handled, with consideration given to the possible need to isolate the facility housing the cabinet, away from human and animal populations.
- Tertiary Barrier: The Building
  Consideration shall be given to the design or selection of the building where the cabinet will be located, with due regard for the requirements of the secondary barrier location (the room) and the proposed work to be conducted.
- Secondary Barrier: The Room

  General considerations:
  - the design of the room, containment properties relating to ventilation and pressure differentials;
  - Class I and Class II cabinets should not be connected directly to the outside atmosphere or to any air handling system within the building (refer to Appendix A AS/NZS 2647);

- adequate lighting, ceiling clearance and space for location of the cabinet;
- internal surfaces of the room (to permit repeated decontamination and cleaning);
- access limited to authorized personnel;
- bio-hazard symbol displayed permanently on all doors;
- accommodation and location of accessories for operation of the cabinet, cleaning of the room, security locking and warning measures;
- suitable measure to provide microbiological isolation of any discharges from contaminated zones of the cabinet e.g. collection and disinfection of liquids removed under vacuum;
- provision of clothing storage, wash-up, cleaning and support equipment;
- hand-washing facilities (preferably hands free) near the cabinet;
- provision of comprehensive standard operating procedures for all activities, including cleaning and maintenance;
- systematic and documented training in safe operation and maintenance of the cabinet, Safe Work Procedures and the principles upon which they are based.

Location of the cabinet:

- away from doorways, passageways, air diffusers etc which could influence cabinet airflows;
- to allow access to exhaust side of cabinet to facilitate filter maintenance with a clearance for exhaust discharge of at least 600 mm, to minimize air turbulence in the room;
- limit personnel traffic, which can generate air movements and cause loss of barrier containment and reduce level of product protection (class II), by using warning signs or partitioning;
- make sure all windows and doors are closed during cabinet operation;
- consider the location of cabinets away from fume cupboards which generate similar inward airflows;
- location should permit the exhaust of fumigant gases to the outside atmosphere;
- location should permit space for cleaning behind cabinet.

Housekeeping and cleaning:

- the laboratory or room where cabinet is housed shall be kept clean and tidy, and free of physical hazards that may cause spillages or breakages;
- good housekeeping and physical cleaning of the laboratory is important for maintaining safe working conditions and the safe operation of the cabinet;
- waste material and unwanted equipment should be removed regularly;
- cleaning of the laboratory shall be carried out by trained personnel in accordance with specific, written and approved procedures;
- contract cleaning staff must complete the SCU “Contractor Induction Training” program (refer to section 4.2.1) before being allowed access for the wet-cleaning of floors only, with a neutral detergent and a mop with a detachable head (to allow for sanitization/disinfection);
- sweeping with brooms and the use of vacuum cleaners shall not be allowed as it produces airborne dust that can increase contamination of work in the laboratory;
- all cleaning should be done outside of normal working hours or when laboratory is not in use.

- Primary Barrier: The Cabinet

  The primary barrier of containment is created by a biosafety cabinet as specified in *AS 2252 (Part 1 or 2)*. The following requirements for the cabinet are specified in *AS/NZS 2647* as follows:

  - all users must have appropriate and documented instruction and training on the safe operation of the cabinet prior to its use. The user must be fully aware of the degree of protection provided by the type of cabinet used, and the controls, alarms and airflow systems of the cabinet.
  - written Safe Work Procedures (SWP) should be prepared and made readily available to all users. The SWP should detail the PPE required when using the cabinet, the functional checks and pre-operational measures, and usage, breakdown and decontamination procedures that are necessary for the safe operation of the cabinet (refer to AS/NZS 2647:7 for details).
  - users must wear appropriate laboratory coats or garments, preferably continuous-fronted, with adjustable or elasticized closures at the wrist. Front-buttoned lab coats are unsuitable as are excessively bulky garments as they may interfere with the barrier containment. The use of over-sleeves and thin protective disposable gloves is recommended. Protective garments should not be worn outside the laboratory. For further information refer to AS 2013 and AS/NZS 2243.3.
  - the installation of germicidal Ultraviolet (UV) Lamps is not recommended, unless required for a specific application, as there are potential hazards and limitations inherent in the use of these lamps (for further details refer to AS/NZS 2647).
  - the use of Bunsen Burners in Class II cabinets is not recommended as they disrupt the laminar flow and barrier air in the cabinet which can render it unsafe for users. Alternative methods, such as the use of electrical heating or disposable instruments, are preferred.
  - the cabinet shall be prominently, legibly and indelibly marked with the following:
    - **CLASS II Biological Safety Cabinet — For Personnel, Environment and Product Protection - Not Designed For Use with Flammable, Explosive or Highly Volatile Liquids, Cytotoxic Drugs or Toxic Compounds;**
    - the **appropriate** biological hazard symbol as illustrated in *AS/NZS 2243.3*;
    - where UV lamps are fitted, a permanent label clearly displaying the following wording shall be attached to the front of the cabinet:

      DANGER! Protect Eyes When Ultraviolet Lamps are Operating

      NOTE: Information on the legibility of signs is given in *AS 1319.*
  - inspection and testing of the cabinet must be carried out by an accredited person in accordance with AS 1807 at the following times:

    - prior to initial use of a newly delivered cabinet;
    - after relocation of a cabinet;
    - after electrical or mechanical maintenance;
    - after HEPA filter replacement;
    - at least annually as organised through the University's Facilities Management and Services contract; and
    - at other times specified by the user if circumstances warrant additional testing.

A test report detailing the results of all tests conducted on the cabinet must be provided to the owner. A certificate, summarizing these results, must be affixed to the cabinet. If a cabinet does not pass the required tests, then it must be clearly marked to show that it is unsafe and must not be used.

Owners and/or users should contact Facilities Management and Services if there are any concerns relating to the inspection and testing of cabinets in their area.

18.5 Centrifuges

18.5.1 Introduction

There are many types of centrifuges in use in SCU laboratories e.g. microfuges, medium and high speed centrifuges, ultracentrifuges etc. Due to the nature of their function and operation, centrifuges can present a hazard to the user, to other laboratory staff, to the experimental work and to the laboratory environment.

Unbalanced loads, rotor failure, or tube or bucket breakage can cause high speed ejection and scattering of infectious or hazardous material. Therefore there are a number of safety issues that should be considered in the first instance when planning to purchase centrifuges. Preference should be given to:

- units with sealed bucket and/or sealed rotor units if working with infectious/biohazardous materials;
- special units designed for handling flammable materials (e.g. fitted with flameproof motor);
- models with minimum vibration and noise, and lightweight rotors;
- adequate shielding against rotor assembly failure;
- an interlocking system that prevents starting unless the lid is properly closed and locked, and also prevents access to the rotor whilst it is in motion;
- automatic controls to switch off the unit when excessive vibration occurs.

18.5.2 Safety Requirements

The following requirements apply to the safe use of centrifuges:

- Training: Persons required to operate centrifuges must receive adequate training in the correct use of the centrifuge including the necessity for precise rotor balancing, correct use of centrifuge tubes and cleanliness/decontamination of the centrifuge;
- Vibration: Medium and high speed bench top centrifuges must be securely anchored to prevent movement caused by vibration;
- Excessive Speed relative to the mass being centrifuged must not be used;
- Location: The centrifuge should be located where vibration will not cause additional hazards, such as glassware or equipment to fall from shelves;
- Centrifuges must not be placed in Class I or II Biosafety Cabinets as this may cause air turbulence that will compromise the containment of the cabinet;
- Centrifuge rotors and tubes must be inspected before use. Any tubes showing damage must be discarded and damaged rotors replaced;
- Logbooks of usage must be kept for medium and high speed centrifuges to ensure timely maintenance and safety inspection of the rotors;
- The manufacturer's instructions should always be followed, and a preventative inspection and maintenance program should be implemented.

Refer to AS 2243.3 *(Section 6.3)* for additional safety requirements for sealed-bucket and sealed-rotor centrifuges.

18.6 Freeze-Dryers

18.6.1 Introduction

Freeze – dryers are used for the freeze-drying, or lyophilization (dehydration) of biological samples. The dehydration process of freeze-drying is different to other dehydration techniques in that it takes

place while the sample is in a frozen state and under a vacuum. These conditions stabilize the sample, minimizing the effects of oxidation and other degradation processes.

18.6.2 Safety Requirements

The following requirements apply to the safe use of freeze-dryers:

- freeze-drying must be carried out in a suitable containment area that is appropriate for the risk group of microorganism being handled (e.g. PC2 for microorganisms of Risk Group 2);
- the manufacturer's instructions should always be followed when operating the freeze-drier;
- the freeze-dryer should be fitted with a 0.2 um hydrophobic membrane filter in the chamber exhaust line to protect the vacuum pump oil from contamination;
- ampoules containing freeze-dried samples should be opened carefully in a Biosafety Cabinet unless it is known that the microorganism is non-pathogenic (Risk Group 1);
- care should be taken when breaking ampoules to protect the operator from being cut.
- unwanted ampoules should be sterilized by heating to 160 C for 2 hours, prior to disposal or be discarded into a sharps container for incineration;
- appropriate procedures should be developed and used when working with cryogenic agents used in the freezing process (e.g. liquid nitrogen, dry ice in ethanol);
- a preventative inspection and maintenance program should be implemented.

18.7 Refrigeration

Refrigeration used in a laboratory should be purpose designed, built and dedicated to ensure that any specimens and other materials can be safely stored and maintained at the desirable temperature.

The following general safety requirements apply to ALL refrigeration used within laboratories at SCU:

- flammable liquids requiring refrigeration MUST be stored in an approved 'explosion proof' or 'spark proof' refrigerator, refer to Section 13.13 Flammable Liquids;
- where a domestic refrigerator is installed in a laboratory a warning sign is to be displayed on the door indicating that 'Flammable liquids or food must not be stored in this refrigerator';
- cold rooms must have door fittings that enable the doors to be opened from the inside;
- an emergency light or luminous sign indicating the position of the door should be fitted to the inside of the cold room.

18.8 Electrical Equipment

18.8.1 Introduction

Electricity has a great potential to injure or kill people in the workplace. In accordance with the legislative requirements the University has a responsibility to ensure that all electrical equipment or plant connected to the electricity supply is:

- safe to use;
- regularly inspected, tested and maintained to ensure it remains safe;
- repaired or replaced if unsafe;
- not used in conditions likely to give rise to electrical hazards;

Specific requirements and recommended practices relating to electrical safety and electrical equipment in laboratories are specified in *AS 2243.7*.

18.8.2 Residual Current Devices in Laboratories

A residual current device (RCD) is an electrical safety device specifically designed to immediately switch off electricity when electrical current "leakage" to earth is detected at a level that is harmful to a

person using plug-in electrical equipment. A RCD offers a high level of personal protection from electric shock. Fuses or over-current circuit breakers do not offer the same level of personal protection against faults involving current/electricity flow to earth. RCDs are also known as earth leakage circuit breakers (ELCB), or safety switches.

RCDs can be installed at the electrical supply distribution board of a laboratory area or building, or within fixed power socket outlets inside the laboratory.

18.8.2.1 Legal Obligations

AS/NZS 2982.1:1997 and *AS/NZS 3000:2000* detail the regulations relating to electrical wiring and services installation in laboratories. They require that all general power socket outlets throughout laboratories be located as required by *AS 2430* and be fitted with residual power protection (i.e. RCD). Selected outlets may be unprotected and may be necessary for equipment requiring high reliability for experimental or operational circumstances (e.g. overnight electrophoresis, freezer operation). In such circumstances a management plan and administrative controls and procedures (e.g. staff/student induction and training) need to be in place for the safe management of these laboratory areas.

Laboratories built prior to the latest edition of the Australian Standards above are required to comply with the legislative requirements in place at the time of the original construction. Major refits or renovations to such laboratories, however, will require upgrading of electrical supply to comply with current legislation. It should also be noted that OH&S legislation encourages the installation of RCDs in existing circuits to provide a safe workplace.

Laboratory managers and/or supervisors must inform all persons using the laboratory if and where RCD protection is provided and the necessary control measures in place for the safe operation of electrical equipment.

18.8.2.2 Labelling of RCD outlets

Power outlets that are not RCD protected must be prominently labelled as per *AS 2982.1* '**OUTLET NOT R.C. PROTECTED**'.

Power outlets fitted with RCDs can also be identified by a label displayed at the outlet. RCD protection at the electrical supply distribution board must be identified by a notice displayed near the distribution board.

At SCU, Facilities Management and Services are responsible for the labelling of power outlets and distribution boards.

In the case where a laboratory is completely or mostly fitted-out with RCDs, or alternatively has limited RCD protected power outlets, then a prominent notice is required at the entrance to the laboratory, detailing the RCD status of the power outlets. Additionally those power outlets that do/do not have RCD protection should also be labelled.

Examples of Laboratory Labels:

Label 1: **Important Safety Notice: Power outlets in this laboratory are not all fitted with RCD protection. Power outlets <u>WITH</u> RCD protection are clearly labelled**

Label 2: **Important Safety Notice: Most power outlets in this laboratory are RCD protected. Power outlets <u>WITHOUT</u> RCD protection are clearly labelled.**

18.8.3 Tagging and Testing of Electrical Equipment

To facilitate the implementation of the legislative requirements, SCU has established Tagging and Testing Procedures for Plug – In Electrical Equipment. These procedures adopt a risk management

approach, where inspection and testing is based on the level of hazard and the degree to which the equipment is typically exposed.

The methodology of the inspection and testing schedule is specified in *AS/NZS 3760:2003 - In-service safety inspection and testing of electrical equipment* as determined by risk assessments. The frequency of testing is based on the environment in which the equipment is used.

Laboratories and associated facilities are by their nature considered to be high risk environments and therefore classified as "hostile environments" according to the Australian Standard *AS/NZS 3760:2003*.

Specifically, all new, hand-held, portable, in-service, fixed or stationary equipment, including power cords, cord sets and power boards, used in laboratory environments are subject to routine in-service electrical testing in accordance with the testing schedule as set out in Table 4 of the Australian Standard.

The Australian Standard's testing schedule indicates an interval of **twelve months** between inspection and testing of Class I (protectively earthed) and Class II (double insulated) equipment, as well as cord sets and power boards.

Residual current devices (RCDs) are also subject to an inspection and testing schedule as detailed in Table 4 of *AS/NZS 3760:2003*. Only a 'competent person' trained in the use of an RCD tester is allowed to test a fixed RCD in accordance with the Standard. If the RCD is located in an electrical supply distribution board, then it must be tested by a licensed electrician.

Refer also to the WorkCover publication *"Electrical Equipment Risk Assessment Checklist"*.

18.8.4 Maintenance of Records

Records of inspection, testing and tagging and maintenance of faulty equipment must be established and are maintained by Facilities Management and Services.

Records should be retained for seven (7) years or as required by specific regulations.

The following should be recorded and kept:

- a register of all plug - in electrical equipment in the laboratory;
- date of inspection, or testing and tagging, or maintenance carried out;
- result or outcome of the inspection, test or maintenance;
- name of person who made inspection, or carried out test or maintenance;
- date by which the next inspection and test must be carried out.

18.9 Robotics

Robotics if used in University laboratories are mainly associated with engineering and medical applications. They can range from small units of limited power to large, very powerful and very fast units that can have many hazards and risks associated with their design and use.

Robotics should be safeguarded by one or a combination of the following:

- guarding, to prevent access by personnel to restricted space;
- presence-sensing devices;
- other safe-guarding equipment that complies with relevant regulations.

Guarding should be incorporated into the design and construction of the robot. The guards should be fixed with no moving parts associated with, or dependent on, the mechanism of the robot.

Robots must also be fitted with an **Emergency Stop** button and be constructed or mounted to prevent unintentional operation.

Robotic systems should be designed to eliminate associated hazards or provide protection against the hazards. Their design and usage should be in accordance with *AS 2939:1987 Industrial robot systems – Safe design and usage.*

Work Units using or proposing to use robotics systems should develop and have documented safety systems and standard operating procedures for the design, location, usage and maintenance of robotics under their control.

There are a number of additional Australian Standards that should be considered in the design and usage of robotic systems:

AS 3000:2000	*Electrical installations – Buildings, structures and Premises*
AS 1543:1985	*Electrical equipment of industrial machines*
AS/NZS 2381.1:1999	*Electrical equipment for explosive atmospheres*
AS 2671:2000	*Hydraulic fluid power – General requirements for systems*
AS 2788:2002	*Pneumatic fluid power – General requirements for systems*
AS 2430:1987	*Classification of hazardous areas*
AS 2243.6:1990	*Safety in laboratories- Mechanical aspects*
AS 2243.7:1991	*Safety in laboratories- Electrical aspects*
AS/NZS 1200:2000	*Pressure Equipment*
AS 1210:1997	*Pressure Vessels*
AS 1345:1995	*Identification of contents of pipes, conduits and ducts*
AS/NZS 3112:2000	*Approval and test specifications – Plugs and socket-outlets*

18.10 Machinery and Hand Tools

There are many machines and hand tools used in laboratories and associated facilities throughout the University. The safe management of these rests with the person(s) in control of the work area in which they are located or used.

When working with machinery, equipment or hand tools of any type, the manufacturer's instructions must be followed as they provide detailed information on safe operating instructions and maintenance requirements that can be used to develop local Safe Work Procedures (SWP) and maintenance schedules.

The following may be useful as a checklist for machinery or hand tools:

- Are safe operating instructions, SWPs and safety signs adequate and clearly displayed?
- Are emergency stop buttons accessible, clearly labelled and painted red?
- Do all machines have anti-start protection?
- Are all areas where PPE is required clearly signposted?
- Is appropriate PPE readily available?
- Is adequate guarding available on all machinery and moving parts?
- Are machines and equipment free from obstruction?
- Are machines and equipment located away from main thoroughfares?
- Is there adequate separation between?
- Are electrical connections, switches etc in good working order?
- Is plug-in mechanical equipment and hand tools checked, tested and tagged? (Refer to Section 18.8 Electrical Equipment).
- Are appropriate fire extinguishers readily available?

- Are work areas clear of obstruction, clean and tidy?

18.11 References

AS 1210:1997 - Pressure vessels
AS 1228:1997 - Pressure equipment – Boilers
AS 1319:1994 - Safety signs for the occupational environment
AS 1345:1995 - Identification of contents of pipes, conduits and ducts
AS 1543:1985 - Electrical equipment of industrial machines
AS 1807.0-25:2000 - Cleanrooms, workstations, safety cabinets and pharmaceutical isolators - Methods of testing
AS 2013:1989 - Cleanroom garments
AS 2182:1998 - Sterilizers – Steam – Bench-top
AS 2192:2002 - Sterilizers – Steam – Downward-displacement
AS 2252.1:2002 -Biological safety cabinets (Class I) for personnel and environment protection.
AS 2252.2:2004 -Laminar flow biological safety cabinets (Class II) for personnel, environment and product protection
AS 2430.3.6:2004 – Classification of hazardous areas – examples of area classification – Laboratories, including fume cupboards and flammable medical agents
AS 2567:2002 - Laminar flow cytotoxic drug safety cabinets
AS 2593:2004 - Boilers – Safety management and supervision systems
AS 2639:1994 - Laminar flow cytotoxic drug safety cabinets—Installation and use
AS 2671:2000 - Hydraulic fluid power – General requirements for systems
AS 2788:2002 - Pneumatic fluid power – General requirements for systems
AS 2939:1987- Industrial robot systems – Safe design and usage
AS 3000:2000 - Electrical installations – Buildings, structures and Premises
AS 3873:2001 - Pressure equipment – Operation and Maintenance
AS 4024.1:2006 – Safety of Machinery
AS 4037:1999 - Pressure equipment – Examination and Testing
AS 4273:1999 - Design, installation and use of pharmaceutical isolators
AS 4343:2005 - Pressure equipment – Hazard Levels
AS 4458:1997 - Pressure equipment – Manufacture
AS/NZS 1200:2000 - Pressure equipment
AS/NZS 2243.3:2002 - Safety in laboratories: Microbiological aspects and containment facilities
AS/NZS 2243.6:1990 - Safety in laboratories- Mechanical aspects
AS/NZS 2243.7:1991 - Safety in laboratories- Electrical aspects
AS/NZS 2243.8:2001 - Safety in Laboratories – Fume Cupboards
AS/NZS 2381.1:1999 - Electrical equipment for explosive atmospheres
AS/NZS 2647:2000 - Biological safety cabinets – Installation and use
AS/NZS 2982.1:1997 – Laboratory design and construction –General requirements
AS/NZS 3000:2000 – Electrical Installations
AS/NZS 3112:2000 - Approval and test specifications – Plugs and socket-outlets AS/NZS 3760:2003 - In-service safety inspection and testing of electrical equipment
AS/NZS 3788:2001 - Pressure equipment – In-service inspection
AS/NZS 3892:2001 - Pressure equipment – Installation
WHS Regulation 2012
SafeWork NSW Electrical Equipment Risk Assessment Checklist

19 Nanotechnology

19.1 Introduction

The emerging field of nanotechnology poses potential OHS risks, many of which are still unknown or unexplored. Whilst the rapid growth of this new technology is leading to the development of new synthetic materials, devices and processes for the electronic, energy, manufacturing, agriculture and pharmaceutical industry (e.g. in cleaning products, cosmetics, sunscreens, etc.), and in medical applications (e.g. nanoparticles used in imaging, drug delivery, advanced radiation therapy etc.), the potential health and environmental benefits lie far beyond our current understanding of its effects on humans and the environment.

The challenge for the future development of nanotechnology "is to ensure that the full potential of this exciting technology can be harnessed, while ensuring that the social, ethical and safety issues are properly addressed" (refer to the Australian Government commissioned report on 'Nanotechnology')

Nanotechnology refers to devices, engineered structures and systems that are too small to be seen by the naked eye. It uses manufactured particles, called nanoparticles and nanotubes, with at least one dimension measured in nanometers – one billionth of a metre or 1/10,0000th (the thickness of a human hair).

Nanotechnology evolved when scientists discovered ways to manipulate matter, such as carbon, zinc and gold molecules, into microscopic clusters. At these scales, materials start to have unique properties that affect physical, chemical and biological behaviour. Harnessing these properties is at the core of nanotechnology.

Small size alone is not the critical factor in the potential toxicity of nanoparticles. The overall number and thus the total surface area (i.e. the dose) are also important. As particles get smaller they gain larger surface area compared to their mass, which can provide greater durability and flexibility, but it can also make them more toxic than larger particles on a mass to mass basis. Nanoparticles also have the potential to release free-radicals that can be potentially toxic to those exposed.

However, the risks of nanoparticles must be managed by a level-headed approach as most of the population and workers in many industries are already exposed to "natural" nanoparticles in polluted air, without significant harm. However, scientists are still trying to understand how **synthetic** or manufactured nanomaterials would travel through the human body, interact physiologically and chemically with the body's systems, and whether these interactions could cause acute or chronic adverse health effects.

There is currently no regulatory control of nanotechnology in Australia, and limited international or national research data on bioaccumulation and long-term toxic effects of nanoparticles on humans and the environment. There is also no agreement on how to measure exposure of workers to manufactured nanoparticles currently used in research laboratories, manufacturing processes, or the environment.

More investigation and research is urgently required to develop internationally agreed protocols for investigating the routes of exposure, toxicology and bioaccumulation effects on humans, other living organisms and the environment. Government and Regulatory Authorities are currently assessing if nanoparticles and nanotubes may fit into existing regulatory frameworks as new types of hazardous substances, with specific occupational exposure limits (OEL) to be determined, and their manufacture and use appropriately regulated.

Work has begun on Australia's national nanotechnology strategy with a national taskforce working towards developing options for the control of nanotechnology in consultation with regulatory agencies, industry, science and ethicists.

19.2 Safety Considerations

Although little is known about exposure routes for nanoparticles or nanotubes, the potential routes for exposure are based on current and potential future applications (refer to report on "*Nanotechnology and Nanoscience*" by UK-based Royal Society and the Royal Academy of Engineering).

Personnel can potentially be exposed to nanoparticles through inhalation, skin contact or ingestion. Studies have shown that inhaled nanoparticles can accumulate in the nasal cavities, lungs and brains of rats, and the buildup could lead to harmful inflammation and the risk of brain damage and central nervous system disorders.

A known risk can be associated with the use of titanium dioxide nanoparticles as used in certain types of self-cleaning windows. These nanoparticles produce large amounts of free radicals which can damage DNA if they are absorbed into skin cells.

Until the appropriate regulation and legislative controls are in place, there is a need for interim control of the manufacture, use and disposal of nanoparticles and nanotechnology to prevent harm to people and the environment. This control should involve a risk management approach, where potential hazards are identified, an assessment of the potential risks of exposure determined, and control measures implemented, using all the currently available information. (Refer to Section 8 Risk Management).

19.3 Controls for Potential Nanotechnology Risks

It is strongly advised that a precautionary approach should be taken by persons involved in any form of nanotechnology research and development. By **limiting exposure** through inhalation, skin contact or ingestion, the potential and often unknown risks that may be posed by nanoparticles can be reasonably managed.

Controls should be identified through the risk assessment process, by making the best possible decisions, given that there is incomplete or inconclusive data on nanoparticles and their health effects.

Control measures to limit exposure should be the same as those involving work with other particles and include:

- high standards of occupational hygiene;
- physical containment of plant and equipment;
- working under ventilation;
- use of suitable personal protective equipment to avoid inhalation and dermal contact (e.g. laboratory coats, safety glasses, gloves, respiratory protection etc).

19.4 References

Nanotechnology – benefits and risks, 1-03-06, WorkplaceOHS
Nanotechnology – concept and OHS implications, 28-09-05, WorkplaceOHS
Nanotechnology – Enabling technologies for Australian innovative industries, March 2005, prepared by an independent working group for the Prime Minister's Science, Engineering & Innovation Council (PMSEIC)
Nanotechnology and nanoscience: opportunities and uncertainties, July 2004, The Royal Society & The Royal Academy of Engineering (website)
Size does matter: workplace nanotech warning, 10-05-06, WorkplaceOHS
Tiny nanomaterials, mega risks? April 2006, Inside OHS

20 Termination of Laboratory Work

20.1 Introduction

The proper termination of laboratory work by staff and students of SCU is a critical risk control measure and is a key component of the University's laboratory risk management program.

Laboratory work can be terminated for a number of reasons. The reasons may include but not necessarily be limited to:

- completion of a degree, research and/or an experiment;
- the cessation of funding;
- a direction from the University;
- transfer to a different laboratory.

A critical aspect of proper termination is hazardous materials management, the responsibility for which lies with each Work Unit.

Whereas each Work Unit is required to develop and implement effective hazardous materials management systems, the ultimate responsibility for the proper disposal of all hazardous materials used in laboratory work rests, in the first instance, with the principal investigator or researcher who is undertaking the work.

If hazardous materials at termination of laboratory work need to be removed by services of an Environmental Protection Authority (EPA) approved contractor the Work Unit will be charged for this service.

Any failure on the part of any person(s) to correctly terminate their laboratory work could, in certain circumstances, lead to disciplinary action by the University and/or the imposition of fines by the appropriate regulator(s) e.g. SafeWork NSW, Workplace Health and Safety QLD or the EPA.

In cases of negligence and where the failure gives rise to injury or property damage the person(s) concerned may also be exposed to common law legal action(s) by third parties.

Any regulatory action(s) e.g. fines, notices etc that are imposed as a result of improper management, poor laboratory termination practice and/or the disposal of hazardous materials may accrue to both the individual and the Work Unit.

20.2 Termination of Laboratory Work Procedures for Hazardous Materials in Laboratories

The following procedures should be completed when an individual (staff or student) terminates their laboratory work.

20.2.1 Chemicals

- ensure that all containers of chemicals are labelled with the appropriate information;
- all containers must be securely closed. Beakers, flasks, evaporating dishes, etc.;
- should be emptied. Hazardous chemical wastes must not be sewered or trashed;
- they must be collected for disposal. Check refrigerators, freezers, fume cupboards
- and bench tops as well as storage cabinets for chemical containers;
- determine which chemicals are useable and transfer responsibility for these materials to another party who is willing to take charge of them. If a new user cannot be found, the materials should be disposed of appropriately;
- all other chemicals should be prepared for disposal. Detailed instructions are available from the technical staff. This process may take quite some time and should be started at least a

month before departure from the laboratory. Chemical pick up should be completed before the laboratory is vacated;
- decontaminate and clean fume cupboard surfaces and counter tops;
- notify supervisor and Technical Manager when the laboratory has been cleared.

20.2.2 Regulated Hazardous Substances (e.g. carcinogens, poisons)
- abandonment of a controlled substance is a violation of the permit under which it was held;
- permission to transfer ownership of a controlled substance to another individual outside the University must be received from the relevant Regulatory Authority;
- controlled substances being held by a licensed individual can be disposed via the technical staff;
- if controlled substances for which the licensee is unknown are found, contact the technical staff.

20.2.3 Gas Cylinders
- remove gas connections, replace cylinder caps and return cylinders to the gas store and notify technical staff of this return.

20.2.4 Animal and Human Tissue
- if tissue is held in a liquid preservative (e.g. formalin), tissue and liquid should be separated;
- human tissue specimens should be placed in a biohazard waste bag for incineration;
- animal tissue can be disposed of by placing in a biohazard waste bag for incineration;
- liquid preservative usually needs to be disposed of as a hazardous waste. Contact technical staff for assistance. Do not assume that the preservative can be sewered;
- if appropriate disposal is uncertain, contact the technical staff;
- defrost and clean refrigerators and freezers if they are empty;
- if samples need to be saved, locate the appropriate person to take responsibility for them and notify the supervisor.

20.2.5 Microorganisms and Cultures
- decontaminate waste by autoclaving. Liquid waste can then be sewered. Solid waste can then be placed in biohazard bags for incineration;
- if material cannot be decontaminated, place in a biohazard bag for incineration;
- decontaminate and clean incubators, drying or curing ovens, refrigerators and freezers;
- if samples need to be saved, locate the appropriate person to take responsibility for them and notify the supervisor.

20.2.6 Radioactive Materials
- refer to the Radiation Safety Manual.

20.2.7 Mixed Hazards
- occasionally it is necessary to dispose of materials that contain more than one of these hazards. Contact the Technical Staff for chemical, radioactive or biological agent assistance.

20.2.8 Equipment
- if laboratory equipment is to be left for the next occupant, decontaminate and clean it before departing the laboratory. If exhaust or filtration equipment (e.g. fume cupboards, biosafety cabinets) has been used with extremely hazardous substances or organisms, alert the Technical Staff;

- if laboratory equipment is to be discarded, be aware that capacitors, transformers, mercury switches, mercury thermometers, radioactive sources and chemicals must be removed before disposal. Contact Technical Staff for assistance;

20.2.9 Shared Storage Areas

- one of the most problematic situations is the sharing of storage units such as refrigerators, freezers, cold rooms, stock rooms, waste collection areas, etc, particularly if no one has been assigned to manage the unit. Departing staff and students must carefully survey any shared facility in order to locate and appropriately dispose of their hazardous materials.

A 'Termination of Laboratory Work Checklist' must be completed, signed by designated persons and forwarded to the Laboratory or Technical Manager for laboratory records.

21 Further Information

Further advice and information to supplement these guidelines can be found in the following documents:

***AS/NZS 2243:1-10* SAFETY IN LABORATORIES AS DETAILED BELOW:**

AS/NZS 2243.1	*Planning and Operational Aspects*
AS/NZS 2243.2	*Chemical Aspects*
AS/NZS 2243.4	*Ionizing radiations*
AS/NZS 2243.5	*Non-ionizing radiations*
AS/NZS 2243.6	*Mechanical aspects*
AS/NZS 2243.7	*Electrical aspects*
AS/NZS 2243.8	*Fume cupboards*
AS/NZS 2243.9	*Recirculating fume cabinets*
AS/NZS 2243.10	*Storage of chemicals*

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