

March 2009

Physics & Astronomy

Safety Handbook

Key Contacts

Emergency Telephone Numbers

Fire, Ambulance, Police	111	Doctor (Health Centre)	6402
Campus Security	6111	Works and Services	6400

Departmental Safety Committee

Jack Baggaley	Chair	6558
Cliff Franklin	Deputy	7611
Wayne Smith		7609

Staff holding First Aid Certificates

	<u>Room</u>	<u>Extension</u>
Cliff Franklin	303	7611
Alistair Lightfoot	303	7611
Graeme MacDonald	209	6583
Graeme Plank	813	7586
Wayne Smith	206	7609
Robert Thirkettle	106	6510

Building Warden

	<u>Room</u>	<u>Extension</u>
Wayne Smith	206/208	7609
Rhondda Sullivan (Deputy)	708	6404

Floor Wardens

Level 1	Robert Thirkettle, Graeme Kershaw
Level 2	Wayne Smith, Geoff Graham
Level 3	Cliff Franklin, Alistair Lightfoot, Lab Supervisor on duty
Level 4	Orlon Petterson, Lab Supervisor on duty
Level 5	Paul Broady, R. Gardiner
Level 6	Jenni Adams
Level 7	Rhondda Sullivan, Roger Reeves
Level 8	Graeme Plank, John Hearnshaw

All staff and graduate students must assume the role of floor or building warden in the absence of the designated persons.

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A. DEPARTMENTAL SAFETY RULES

1. Students and staff must wear safety glasses and laboratory coats in laboratories and workshops except for those areas which have been officially exempted from this requirement.
2. Proper footwear must be worn in all laboratories and workshops. The whole foot must be protected and non-skid soles are recommended.
3. Smoking is prohibited in the building.
4. Eating and drinking in laboratories is prohibited.
5. Work with hazardous or toxic materials must not be undertaken without proper precautions. If any doubt exists consult your supervisor or the Safety Officer (Jack Baggaley, Room 816, Ext. 6558).
6. All accidents must be reported to the Safety Officer or Deputy Safety Officer immediately. This is particularly important when the circumstances leading to the accident are likely to recur. Acquaint yourself with the first aid equipment provided.
7. ***FOR MEDICAL ATTENTION PHONE STUDENT HEALTH SERVICE (EXT. 6402). IF NO REPLY DIAL 111.***
8. No staff or students are permitted to work in an office, laboratory or workshop with the major access door locked.
9. Undergraduate students are not permitted to work in class laboratories outside the prescribed hours.
10. No student or staff is to carry out experimental work in a laboratory unless a second person is within call. No student is to work in a laboratory after 11 p.m. without written permission from a supervisor.
11. LPG Isolation valve switches are to be turned off by the last person to leave a laboratory, after having first checked that all gas taps are closed. This should be attended to at the end of each day and particularly in the event of emergency evacuations.
12. No undergraduate is to leave an experiment running overnight without obtaining permission from a supervisor. Graduate students who find it necessary to run such experiments are expected to take all reasonable precautions, and should always consult their supervisor. An "Operating Equipment" card is to be displayed beside the equipment and at the doorway to the laboratory.
13. Corridor doors and windows must be kept closed outside normal working hours. You are expected to ensure that after 6.00 p.m. and during weekends or holidays the entrances to individual floors, and all ground-floor windows are kept closed.
14. Students are not permitted to carry out electrical wiring on equipment or extension cords.

B. GENERAL INFORMATION

1. Keys and work outside normal departmental hours

The main doors of the Physics and Astronomy Department and corridor doors are kept closed outside the hours of 8.00am and 6.00pm Monday to Friday, with some corridor doors on teaching laboratory floors locked at all times except when laboratories are operating. Research workers and students must consult with the Head of Department (Room 710, Ext. 6541) before collecting their keys or cards from Registry. Students should refer to Section E and A.11 for the conditions under which experimental work may be carried on outside normal working hours. Outside normal working hours access cards must be carried.

2. Cryogenics

LN₂ available from Cryogenics, 1st floor. See Bob Flygenring (Room 114, Ext. 7512).

3. LPG (Liquefied Petroleum Gas)

LPG reticulated through pipes in the building for use in LPG burners. It should be noted that LPG itself is odourless and because of this an odorant (ethyl mercaptan) is added in trace amounts so that gas leaks will be noticed. (Familiarise yourself with this odour). LPG is heavier than air and could therefore accumulate on floors, sinks, drains, etc in explosive mixtures with air. For this reason all laboratories provided with LPG have individual solenoid-controlled isolation valves. When the indicator light (both on the switch by the laboratory door and in the corridor outside) is on the isolation valve is open. Whenever LPG is not in use or when the laboratory is vacated all isolation valves must be switched off (lights off - valve closed)

4. Equipment maintenance

All electrical equipment must be kept in a clean usable condition and not left in fume cupboards.

Regular inspection of electrical equipment is required by law, if you find any equipment to be faulty, immediately unplug and label the equipment as faulty and notify Ross Ritchie (Room 207A/209, Ext. 7576 or 6583). Any portable equipment without a safety sticker should be brought to room 209 to be checked. This includes any equipment brought into the Department by individuals.

Equipment such as magnetic stirrers - hot plates, heating mantles, balances, ovens, vacuum pumps requiring servicing should be reported to Wayne Smith (Room 206.208, Ext. 7609), Graeme Kershaw (Room 106, Ext. 6510).

5. Breakdowns in services

Breakdowns should be reported to Graeme Kershaw (Room 106, Ext. 6510). In his absence serious breakdowns should be reported to Works & Services (Ext. 6400) or to Security (Ext. 6111). Lift breakdowns should be reported to the Custodian (Ext. 6480).

6. Use of special equipment

Students who need to use some of the Department's special equipment must first consult their supervisor. He/she will refer the student to the staff member who is responsible for the instrument. In no case should a student begin to use an instrument without a clear understanding of the operating procedure.

7. **Material Safety Data Sheets, Chemical Databases, and Health and Safety Information**
See Chemwatch <http://chemwatch.canterbury.ac.nz>. Chemicals are not stored in the Department.
8. **Other services and facilities**
There are Ethernet connections to the University network via computers in Room 817. EMAIL facilities are available.
Photographic services: Cliff Franklin is the person to contact regarding the Department's digital camera (Room 303, phone 7611).
Photocopying private photocopying charges are posted by the photocopier. Money for private photocopying should be given to the Departmental administrator.
Employment possibilities. Information posted on 7th floor noticeboard and on the Department's web page http://www.phys.canterbury.ac.nz/for/Positions_Available.shtml.
9. **Leaving apparatus on overnight**
a) If electrical apparatus, on the approval of a staff member, needs to be left on overnight in research labs an "Operating Equipment" card must be displayed beside the equipment. These cards are available from Room 705.
b) Electrical equipment not required for immediate use should be switched off.
10. **Procedure when research work has been completed**
Once bench work has been completed students in consultation with their supervisor must:
- Clean up their laboratory work bench including fume cupboard.
 - Return chemicals and glassware to the store, Room 613.
11. **Chemical Store**
There is a small chemical store in room 625, associated with the RF Furnace. Instructions on the door must be followed at all times, and the door must be kept locked at all times.
12. **Nuclear / Radiation**
See Appendix E.

C. EMERGENCY PROCEDURES

1. FIRE

Fire is one of the greatest potential hazards in the building and every effort should be made to avoid the possibility of starting a fire. Examples of hazards include: bunsen burners left on; water baths running dry; electrical equipment in poor maintenance; and lack of precautions when handling flammable solvents.

The building is protected by an Automatic Sprinkler Fire Alarm System. If an outbreak of fire was serious it would activate the ceiling sprinkler head above the fire, releasing a continuous spray of water, it would also activate the fire horns and automatically notify the Fire Brigade.

a) Small Fire Emergency

Prompt action will often prevent a small fire from becoming a major disaster, e.g. smothering the flames with a wet towel or even a notebook, and the use of the correct type of portable fire extinguisher, are very effective.

Any person becoming aware of a small fire which has not activated the automatic fire detection system, should raise the alarm by operating the nearest alarm and ringing emergency number 6111. Operate a fire extinguisher only if it is safe to do so.

If the situation does not respond to "first aid" fire fighting methods, close the room doors, warn others by shouting an alarm and leave the immediate area.

b) Fire Extinguishers

The following types of fire extinguishers are installed throughout the buildings. Everyone should be familiar with their proper use.

<u>TYPE AND LOCATION</u>	<u>COLOUR</u>	<u>TO USE</u>	<u>USE AGAINST</u>
Dry Powder; in high risk areas	Red with white band	Remove pin or break seal, squeeze handle	General purpose, especially solvent fires
CO2 Gas; throughout	Red with black band	Remove or break seal squeeze handle	General purpose, especially electrical fires
Hose Reels; 2 per corridor		Turn on stop valve, turn nozzle and control water flow	Paper, rubbish, wood

- i) Used extinguishers. When an extinguisher has been used, immediately notify the departmental administrator who will arrange to have it recharged. A used extinguisher should be laid on its side on the floor.
- ii) Blankets are provided in the storeman's office (in the loading bay). They could be used for smothering the flames when a person's clothing is alight. Do not roll a person in a blanket if clothes are alight as the blanket could act as a chimney and divert the heat and smoke towards the face.

2. CHEMICAL HAZARDS

- a) If you have a major spillage, a cylinder or apparatus leaking a hazardous gas or a reaction that has become potentially explosive or any such sudden emergency immediately contact one of the following persons for advice on what to do.

<u>Name</u>	<u>Room</u>	<u>Phone</u>
Ross Ritchie	209	6583
Graeme Kershaw	106	6510
Cliff Franklin	303	7611

- b) All preparations and chemical operations which constitute a significant hazard must be carried out in the room on the sixth floor designed for such purposes (Room 613) in the Physics Department.
- c) Emergency life support units are available on all floors. Breathing apparatus, located on level 1 of the Chemistry Department, are to be used only by those qualified to do so.
- d) There are handheld (H/H) and eyewash stations (E/W) in the following rooms:

Room:

106	E/W
107	H/H
116	H/H
117	H/H + E/W
208	H/H
409	E/W
411	H/H
613	E/W + Fullbody shower
623	H/H
717	H/H (inside 715)

3. EARTHQUAKE

- a) In the event of a strong earthquake take immediate cover under any solid structure table, bench, doorway.

- b) **When an earthquake happens:**

Get under your desk (stand in a doorway or lie beside a solid structure and hold on).

Desks will walk if the shaking is strong enough.

Do whatever is necessary to survive. Stay a survivor!

When shaking stops:

- If a fire has started put out if possible.
- Check for electrical and gas hazards – there's no point in becoming a casualty once you've survived the quake.
- Turn off all electrical switches and gas taps.
- Assist those nearest to you who may be injured.
- **Do not go outside** – the hazards out there may be worse, example: falling masonry/glass.
- Wait for instructions from your Warden.

If an evacuation is initiated:

- Keep together with your group.
- Follow you Warden’s instructions
- Proceed to an assembly centre.

4. BOMB THREAT STRATEGY

If you receive a bomb threat **stay calm**. Get as much information as possible (use the “green card” to assist you). Contact the Floor Warden (or the Building Warden) directly.

The **Building Warden** is the **Incident Control Officer**. This person is responsible for ensuring that Police are informed immediately. The Building Warden will co-ordinate all search procedures and make any decisions regarding evacuation or re-entry. If the Building Warden orders an evacuation, exit by the same routes used for fire, unless directed otherwise by the Floor Warden.

5. ACCIDENTS

An accident is an event that causes a person to be harmed, or could, in different circumstances cause a person to be harmed. An incident is a "near miss" accident that generally doesn't cause injury.

When an accident happens:

1. Give [first aid assistance](#) if required, and do not hesitate to call an ambulance if the injury is serious.

2. Contact:

Cliff Franklin	rm303	x7611
Alistair Lightfoot	rm303	x7611
Graeme MacDonald	rm209	x6583
Graeme Plank	rm813	x7586
Wayne Smith	rm206	x7609
Robert Thirkettle	rm106	x6510

for guidance if required.

3. Keep unnecessary people away from the scene.
4. If the accident involves serious harm, do not interfere with the accident scene except to treat an injured person or prevent further injury or serious damage to property.

All accident injuries must be reported promptly to the Safety Officer or Deputy Safety Officer. Also a University “Accident or Serious Harm Report” form which is available from the mail room, off the photocopier room (room 709), must be completed as soon as possible and returned to the Safety Officer. This assists the university to meet its requirements under the Health and Safety in Employment Act to record and investigate accidents, and remedy or monitor hazards.

A critical incident is an unforeseen and traumatic crisis event which could cause severe stress to the person who witnesses it. Examples include workplace violence, witnessing a fatality or near fatality, bomb threats, assault, explosions, etc. If a critical incident involves injury, follow the steps above. In all cases, contact the [University Security Centre](#) and inform them of the situation.

6. FIRST AID ASSISTANCE

The Department has a number of First-Aid Officers who are available for assistance after an injury. A Medical Practitioner is available at Student Health Service. For details see the EMERGENCY and SAFETY INFORMATION notices which are displayed throughout the building.

The following persons have current first aid certificates.

	<u>Room</u>	<u>Extension</u>
Cliff Franklin	303	7611
Alistair Lightfoot	303	7611
Graeme MacDonald	209	6583
Graeme Plank	813	7586
Wayne Smith	206	7609
Robert Thirkettle	106	6510

For professional first aid help, first phone the Health Centre, Ext. 6402 day and night. In the case of serious injury or illness telephone Security 6111 and request an ambulance.

First aid facilities in the Rutherford Building are:

- a) First Aid Room. A First Aid Room is located on level 3 of Chemistry at the south end. Bruce Reid (Room 834, Chemistry) must be notified as soon as possible when this room has been used.
- b) First Aid Boxes are located on each floor. These are clearly identified by a standard First Aid sign. The stock levels of First Aid requisites as determined by Cliff Franklin must be maintained.
- c) Showers and Eyewash Stations are located throughout the building.. The nearest safety shower is located in the link block on level 8

Room:

108	E/W
109	H/H
118	H/H
119	H/H + E/W
209	H/H
409	E/W
412	H/H
613	E/W + Fullbody shower
624	H/H
717	H/H (inside 715)

- d) Stretcher. A stretcher for emergency use is available in the stores office (Room 109, Physics & Astronomy Loading Bay).

D. EVACUATION PROCEDURES

When fire horns sound you must leave the building immediately, using either the stairs in the link block or north end of the building, and assemble on the grass area on the west side of the building by the Physical Sciences Library. Do not gather too close to the building.

DO NOT USE LIFTS. They may fail in an emergency.

If a person is unable to leave the building by stairs, leave them with someone near the main lifts and contact the building warden or fire brigade immediately on reaching main fire exit.

1. FIRE ALARM

- Turn off all bunsen burners.
- Electrical equipment that cannot be left unattended, must be turned off.
- Close the windows.
- Turn off LPG isolation valve switch.
- Leave the room and close the door.
- Make sure all the corridor doors are closed to prevent draughts. **Do not activate fire doors at lift end.**
- Leave the building under the direction of the floor warden, using the stairs in the link block or north end of the building.
- If for some reason a warden is missing, any member of staff should be prepared to take over.

2. EMERGENCY WARDEN

During normal working hours Floor Wardens have been appointed to all floors. All staff are required to co-operate and comply with their instructions during an emergency and, if wardens are absent, take over their role.

The following persons have been appointed as wardens for the Physics and Astronomy Department.

Floor Wardens

Level 1	Robert Thirkettle, Graeme Kershaw
Level 2	Wayne Smith, Geoff Graham
Level 3	Cliff Franklin, Alistair Lightfoot, Lab Supervisor on duty
Level 4	Orlon Petterson, Lab Supervisor on duty
Level 5	Paul Broady, R. Gardiner
Level 6	Mike Reid
Level 7	Gill Evans, Roger Reeves
Level 8	Graeme Plank, John Hearnshaw
<u>Wayne Smith has overall charge of the evacuation of the building.</u>	

Responsibilities of Wardens

- Instructing all personnel to leave the building immediately the fire alarm sounds.
- Ensuring as far as possible that their floor is clear.
- Reporting to the Building Warden the location of persons remaining in the building.
 - i) disabled persons and escorts
 - ii) persons trapped
- Checking that all LPG isolation valve switch indicator lights are off.
- Removing tag from north end of floor and placing the tag on the fire clearance board to show

that floor is clear.

- To wear the wardens arm band which is situated beside the floor tag.

3. UNDERGRADUATE LABORATORIES

Staff in charge of undergraduate laboratories should get students to stop their work, turn off burners, turn off electrical gear and shut windows and doors.

In the event of the fire preventing you leaving by the designated exit, be sensible and use the exit at the other end.

After leaving the building, move away on to the grass to the west side of the building.

Any comments or suggestions regarding emergency evacuation procedures within the Department should be directed to Wayne Smith (Building Warden) or Jack Baggaley (Safety Officer).

E. ACCESS TO THE BUILDING

1. Normal Working Days

The doors of the building are open from 7.30 am to 6.00 pm Monday to Friday on normal working days.

2. Night Time, Weekends, University or Public Holidays

The doors of the building are locked throughout all holidays, and every night between 6.00 pm and 8.00 am during which time the only entry and normal exit is via the front door on the Physics and Astronomy side of the entrance foyer and the north end of the building.

3. Working Outside Normal Hours

Any inherently hazardous operations should never be carried out alone, they should only proceed when informed people are in the vicinity; nights and holidays should be avoided, but if this is not possible, at least one other person should be within easy call and know that the operation is being performed.

All equipment not in use must be turned off at the power outlet during the night, weekend etc. Equipment which must operate unattended at such times must have an equipment card (available from Room 705) displayed in a position easily read by security guards. Cards must be signed by a supervisor.

4. Visitors

All Visitors are the responsibility of their host. In the event of an emergency, all long term visitors must be made aware of the safety requirements and evacuation procedures of the department.

Contractors must liaise with Graeme Kershaw, Room 106, Ext. 6510, before commencing work within the Department.

The practice of staff members bringing in young children into the Department, especially in the evening or at weekends, is potentially dangerous and undesirable. Laboratories and workshops are strictly out-of-bounds to children.

5. Department Workshops

Use of machinery restricted to authorised staff only. Visitors to workshop must report to workshop office. All staff and students must wear suitable protective footwear and be aware of hazards related to the environment.

F. PERSONAL PROTECTION

1. Potentially Hazardous Situation

All staff and research students are encouraged to report to Jack Baggaley, Cliff Franklin or a member of the Safety Committee, any perceived or suspected hazardous situation or practice, including a “Near Miss”! A Hazard Form, available from the main office (room 705) should also be completed and returned to Cliff Franklin, Room 303. These forms are also available from the mail room off the photocopier room (room 709),

2. Hazard Identification

Copies of the following forms are available from the Office (Rm 705) or from the mail room off the photocopier room (Rm 709).

HAZARD/INCIDENT ALERT
ACCIDENT OR SERIOUS HARM REPORT
SELF-REPORT OF DISCOMFORT AND PAIN

3. Dress

The Department's safety rules on dress must be observed. They can be briefly summarised as follows: Each worker in a Laboratory, Store or Workshop must wear adequate town or walking shoes, suitable eye protection and specially provided protective gloves, and footwear or clothing when necessary. Long hair must be properly confined to avoid entanglements.

4. Eye Protection

In any laboratory containing glassware and/or chemicals there is an ever present risk of serious eye injury. If you are at risk of serious injury due to events in any part of the laboratory, you must not take off your safety glasses. Supervisory staff should be particularly vigilant in bringing such risks to the attention of other staff, and ensuring that appropriate protection is provided and used.

Simple safety glasses with shatterproof lenses and protective side panels are adequate for most laboratory situations. Students who wear contact lenses are however subject to an especial hazard. In the event of chemicals entering the eye it is often difficult to remove contact lenses in order to allow thorough washing of the eye. This makes it essential that further safety measures are undertaken. Contact lens wearers should either arrange to wear prescription safety glasses in the laboratory and thereby avoid the problem or they should wear full protective goggles whilst in the laboratory.

Where ultraviolet light is being used (e.g. in photography, lasers or UV spectrophotometers etc.) appropriate protective glasses must be worn.

All laser light sources must be regarded as potentially dangerous. Never look directly into a laser beam, or a beam reflected from another surface. Laboratories containing analytical equipment fitting with a laser light source should display the standard “Caution/Danger Laser Beam” sign on the door. Any procedure requiring an exposed laser beam, must be performed by a suitably protected and qualified person, during which time a “NO ENTRY” sign must be displayed on the door.

5. Food and Drink in Laboratories

Eating lunches and brewing tea or coffee in laboratories is unacceptable for obvious safety reasons. In particular, never drink from a beaker or flask: this practice has led elsewhere to fatal accidents. Foodstuffs must not be stored in laboratory refrigerators or warmed in laboratory ovens. The only place food may be heated is in the cooking equipment in the seminar room (701) and Room 205.

6. Smoking

Smoking is prohibited in the building.

7. Running in the Building

Except in an emergency, do not run within the building. A collision with another person carrying something could be very serious, and slipping on floors and stairs is a common cause of injury.

8. Unsafe Condition Report

When anyone in the Department considers that there is a deficiency in current safety procedures, or that improvements could be made in certain areas, there are a number of communication avenues open to the person. The matter can be reported to a member of the Safety Committee. The Safety Committee member will then, after broader consultation, decide whether there is a case for taking the matter to the Chair of the Safety Committee. If the matter concerns a change in Department policy, the Chair will convene a meeting of the Safety Committee to discuss the issue.

G. SEXUAL HARASSMENT / GENERAL HARASSMENT

Harassment can happen to anyone: students, staff, women or men. It can also come from anyone. Sexual harassment usually involves abuse of power, and is serious and distressing for the recipient of harassment. Please refer to the notices distributed around the University giving details of Sexual Harassment Officers.

A pamphlet on sexual harassment, and a complete listing of people throughout the University that complaints can be directed to is available from Registry.

Remember: if you are being harassed, it is not your fault. You have the responsibility to yourself and to other potential victims to do something about sexual harassment immediately.

H. SAFETY IN THE USE OF EQUIPMENT

1. Glassware

Glass apparatus which is cracked or has jagged edges must be repaired or disposed of immediately. The most common causes of major or minor cuts to the hands are:

- a) Handling damaged glassware
- b) Pushing glass tubing through a hole in the rubber stopper
- c) Fitting flexible tubing to a glass tube or outlet

The possibility of injury arising from (b) and (c) can be reduced by using tubing of the correct size together with a small amount of lubricant (glycerol and ethanol, or preferably water).

- a) Pipettes. Never use mouth suction pipetting for any substance or solution that could be injurious if it entered the mouth, eg. strong acids, alkalis and solvents. There are several excellent mechanical-suction devices for pipettes quite readily available.
- b) Glassware under Vacuum. All glassware subject to vacuum conditions must be of the correct design and manufacture, it should be periodically checked for strain and damage, and all such glassware drawn “new” from store should be similarly checked before use. Strain checks and annealing, if required, can be carried out by Glassblowing Workshop (in Chemistry).
- c) Dirty Glassware. All dirty glassware should be rinsed free of harmful chemicals before being set aside for washing up.
- d) Chromic Acid Cleaning. All containers of “Chromic” or other acids for cleaning pipettes etc. should be of polythene (with or without a glass liner) and should be secured to a wall by an easily removable polythene strap.

These and other containers of “acid” should also stand in a vessel or tray large enough to contain the whole volume should the container develop a leak.

2. Electrical Equipment

All work involving the electrical installation of the buildings, i.e. fittings, fixed wiring, switchboards, etc., shall be carried out by Works and Services staff.

Repair or modification to all equipment capable of being connected to the electrical installation of the buildings shall be carried out only by authorised electronic or mechanical workshop staff.

All new and externally borrowed mains operated equipment must be inspected and approved by Ross Ritchie in the Electronics Workshop (Room 209), before that equipment may be installed.

Electrical leads should be removed from the power outlet by pulling on the plug, and not on the cable.

Electrical cables should be kept off floors to minimise hazards and to assist the cleaners. If this is unavoidable then a ramped cover must be installed over the cables to facilitate the movement of equipment and to minimise accidents.

- a) Circuit Breakers. When a circuit breaker has “tripped” on overload, the circuit and its load must be checked by an authorised person before power is restored.
- b) Multi Outlet Power Boards should be fixed to a vertical surface and not left lying “socket up” on a bench top, or on the floor.

- c) Double Adapters. Not more than one double adapter may be used per power outlet.
- d) Electric Heaters. “Open bar” radiators and fan heaters in Laboratories and Stores are unacceptable fire and explosion hazards and must not be used. Hair dryers are equally hazardous in the presence of flammable solvents and should be used with extreme care. Modern hot plates and hot plate/stirrers are usually suitable for work with flammable solvents. Care must be taken not to use those of older designs that could have open heaters under the top plate.
- e) Refrigerators. ***NO FLAMMABLES SHOULD BE STORED IN REFRIGERATORS UNLESS SPECIALLY MODIFIED.***

3. **Water cooled systems**

- a) Connections to metal pipework should be made either with copper tubing via the appropriate fittings or with the yellow tubing and secured with the metal band clamps available from the Instrument Workshop (if in doubt see Wayne Smith in the Instrument Workshop or Graeme Kershaw in the Mechanical Workshop). Tubing attached to a tap must be securely clamped and drain lines held in position.
- b) Rubber tubing in good condition can be used for glass condensers, however, if these are to be left unattended for long periods the tubing must be secured to the tap and the condenser with tube clamps.
- c) The water pressure to the building can vary overnight and sudden changes in pressure can part poor connections.
- d) If cooling water is not required overnight then turn it off before you leave.

4. **Fume Cupboards**

Fume cupboards should not be used for storage of dangerous chemicals. N.Z.S. 7203. If fume cupboards are found in an untidy and hazardous state and used to store chemicals the laboratory in which it is situated will be closed down until the accepted standards are met.

The sash on the fume cupboards must be pulled down below the indicated mark at all times, except when setting up equipment. This allows an adequate air flow through the cupboard.

Any queries as to the suitability of a fume cupboard for a specific operation must be directed to Jack Baggaley, Cliff Franklin or a member of the Safety Committee.

Fume cupboards should be kept clean and clear of all unnecessary bottles and apparatus, and the practice of storing materials in a fume cupboard is prohibited.

5. **Gas Cylinders**

All gas cylinders must be securely chained or strapped in an upright position to a bench or wall. Proper trolleys should be used for transport of cylinders. Some other precautions are:

- a) Do not store or use compressed gases in unventilated areas.
- b) Avoid mechanical damage to cylinders or their control valves: their destructive potential is unbelievable.
- c) Do not use undue force in opening or closing a valve. Never use oil or grease!
- d) Special precautions are needed when using compressed (or liquefied) toxic gases such as chlorine, ammonia etc. The Departmental Safety Committee must be consulted before such cylinders are brought into or used in the Department.

- e) All gas cylinders not connected to apparatus must be stored in the Chemistry Department gas bottle store. Access to this is via the Chemistry Storeman.

6. Minor Maintenance

Minor maintenance jobs, such as leaking taps, faulty lights, steam leaks, faulty electrical switches, etc., should be reported to Graeme Kershaw as soon as possible.

In cases where a potential hazard is involved (e.g., leaking gas taps) contact Works and Services (Ext. 6400) directly or Security after hours (Ext. 6111).

I SAFETY IN THE USE OF LABORATORY SPACE

1. General Laboratories

Good housekeeping should always be maintained; it is an essential part of basic Laboratory practice and Laboratory safety.

- Dispose of unwanted materials immediately
- Clean up all spills right away
- Maintain adequate working space
- Keep floors and exits clear of apparatus and materials

J. SAFETY IN THE USE OF CHEMICALS

1. Use and Transport of Chemicals

Many chemicals cause poisoning if they are inhaled, ingested, or come into contact with the skin. Some chemicals, if improperly handled, cause fire or explosion. Memorise the emergency safety routines and know where to find fire fighting equipment and the nearest large sink and eyewash stations. Above all, familiarise yourself with the hazards of, and the control procedures for, the chemicals that you use.

All containers must be clearly labelled with the current contents. Containers should never carry more than one contents label and unlabelled containers should be taken to the Chemistry Issue Store for disposal. Unlabelled containers are the responsibility of the supervisor of the laboratory in which they are found.

Before obtaining a new hazardous chemical or instituting a new hazardous procedure it is essential to check with your supervisor, Safety Officer or member of the Safety Committee. It is the responsibility of persons using dangerous materials to warn relevant personnel of the potential hazard. When new unusually hazardous chemical is brought into the laboratory an "Unusually Hazardous Substance Form (PSH2)" must be completed and a suitable hazard control procedure devised. The relevant Material Data Sheets must be studied and be in easy access for when required.

Problems have arisen in the Department because stocks of hazardous chemicals that are no longer needed tend to build up over the years. To prevent this, order the minimum needed for the work in hand. For example if you need 10mL of a solvent, get it from a colleague rather than obtaining a large volume.

Experiments using dangerous chemicals must be carried out in fume cupboards.

Special precautions are needed with highly toxic volatile materials (e.g. HCN) or large quantities of flammable solvents. Never use naked lights or non-spark-free electrical appliances near flammable or explosive solvents. Experiments involving quantities of flammable solvents or any other hazardous material or procedures would not be conducted outside normal working hours (8.30 am - 5.00 pm). If you have to carry out a hazardous procedure, even during normal hours, make sure that your colleagues know what you are doing.

In the interests of safety, bulk chemicals and potentially hazardous chemicals in any quantity should not be carried in the passenger lifts. In addition:

- a) The following chemicals are banned from passenger lifts in any quantities: Strong acids and bases, volatile solvents, flammable liquids and toxic solids.
- b) Large gas cylinders and filled cryogenic dewars are not permitted unless the proper procedures are followed.

Alternative arrangements to transport items referred to in b) in the goods lift must be made with Cryogenics staff.

All quantities of acids, caustic, flammable or dangerous liquids should be transported in a "Winchester Carrier" to and from laboratories and stores in the goods lift.

2. Carcinogens

Every effort should first be made to find an alternative chemical that is not a carcinogen.

- a) Storage of Carcinogenic Substances. Containers should be placed in a polythene bag, sealed with sellotape and clearly labelled:
“CARCINOGEN” or “SUSPECTED CARCINOGEN”
and stored away from other chemicals.
- b) Handling Carcinogens. Personal protection is required to prevent any absorption through the mouth, lungs or skin (see appendix D).
Small amounts may be weighed and dispensed in a small disposable cabinet.

3. Liquid Nitrogen and Solid Carbon Dioxide

Liquid nitrogen is a dangerous material. Safety spectacles should be worn when transferring it into or out of a vacuum flask, no matter what the quantity.

- a) Transporting: for the safety of yourself and others.
 - i) Liquid nitrogen should never be transported via the staircase.
 - ii) Up to one litre of liquid nitrogen in a Dewar flask covered with a lid can be carried by a person via the lifts.
 - iii) Volumes larger than one litre should be carried in containers secured on trolleys. If the trolley is to be transported between floors, then the lifts should be used. In this case, the trolleys should be sent in the lifts unattended, but with second person outside the lift door of the receiving floor ready to move the trolley out of the lift. A very large and conspicuous notice stating “DANGER, DO NOT ENTER THE LIFT” should be attached to the trolley, facing the lift doors.
- b) All liquid nitrogen containers should be completely emptied at least twice a year, because of the gradual accumulation of liquid oxygen.
- c) Liquid nitrogen traps on vacuum lines tend to liquefy air passing through the trap as well as organic vapours, to give a dangerous combination. Do not draw air through a trap unnecessarily and always empty the trap immediately after use.
- d) Both liquid nitrogen and solid carbon dioxide must be stored in a ventilated area: never in a Cold Room.
- e) Liquid air should never be used in the department.

4. Oxygen

Ensure that oxygen cylinders are shut off securely when not in use, and that there are no leaks in an “oxygen system” when in use. The risk of fire is considerably increased by an oxygen enriched atmosphere.

5. Storage of Chemicals

- a) Oxidising and dangerous acids should be stored standing in a plastic tray. Strong acids should not be stored close to solvents.
- b) Ensure that flammable and corrosive chemicals are **NEVER** in the same cabinet.
- c) Bottles larger than one litre should not be stored on shelves above eye level.
- d) Winchester bottles whether empty or containing liquid should not be stored on the floor.

- e) The practice of storing materials in a fume cupboard is prohibited.

6. Disposal of Chemicals

Information on the disposal of chemical wastes can be found on M.D.H.S. system located on level one corridor (Chemistry). Consult your supervisor or Peter Harland if in doubt. Each individual user carries the responsibility for checking on the properties and disposal methods for materials used. All bottles must be labelled and all wastes delivered to the store must be labelled and rendered safe to handle by untrained personnel. A "Waste Disposal Request Form" is required for each item.

Water miscible solvents may be poured down the sink with dilution. All chemicals which cannot be disposed of via the sewage system must be neutralised and labelled, and returned to the store for disposal at a later date via a controlled land fill site.

Solvents must not be poured down the sink. They must be collected in "solvent residue" bottles, which will be emptied regularly. Do not mix acetone and chloroform in the residue bottles; the resulting mixture may explode. Solvent residues and other materials for disposal may be left in the designated area of the Chemistry Store after advising the Storeman, who will reject the items if unsatisfactory for disposal. The Safety Committee will assist groups to dispose of hazardous, water immiscible and flammable materials, and should be consulted.

If you are about to leave the Department or complete a project, consult your supervisor about safe disposal of any hazardous chemicals you may have remaining in your laboratory.

Also see Appendix A.

8. Accidents Involving Chemicals

For the safety of others, spillage of chemicals on benches or floors must be cleaned up immediately, irrespective of whether they are dangerous or not.

If a major spillage of a dangerous chemical occurs, warn other people to keep clear of the immediate area and seek assistance from the Safety Officer or a member of the Safety Committee.

9. Multi-Gas Detector

A Gastec Multi-Gas Detector is kept in Room 834 (Chemistry) with the following detector tubes: carbon monoxide, hydrogen fluoride, LP Gas.

Appendix A

Disposal of Chemical Wastes Policy University of Canterbury

Following the 15th December 1993 meeting between the Christchurch City Council waste disposal personnel, Departmental Safety Officers and Chemistry Department Safety personnel, the following Policy for waste management at the University of Canterbury is to become effective from the 1st March 1994.

1. The Chemistry Department (contact person Richard Hartshorn, 6874) which has accepted responsibility for the organisation and co-ordination of hazardous material management for the campus, will become the collection point for the disposal of chemical wastes. The contact person in the Chemistry Department Store is Laurie Anderson, extension 6468.
2. Waste management begins with the individuals generating the materials for disposal. Before embarking on processes resulting in wastes for disposal the following questions should be considered:
 - a) Is the experiment (process) really necessary?
 - b) Are there alternative reagents or conditions that would reduce the wastes or generate less undesirable waste?
 - c) Could the quantities be reduced without affecting the conclusions to be drawn from the work?

Individuals must accept responsibility for the correct treatment and labelling of wastes and sign for them before they are passed on to the Chemistry Department or others for disposal. Each Department must maintain a Register of waste materials which includes the date, identity of materials, quantities and provider. Remember, handlers downstream will not be trained scientists and they will assume that the materials they are handling are safe.

3. Solvents for disposal must be separated at source into five categories and priority should be given to re-use or distillation:
 - (i) halogenated;
 - (ii) water soluble;
 - (iii) water insoluble – “clean”;
 - (iv) water insoluble – “dirty”;
 - (v) involatile liquids.

“Clean” means free of dissolved solids and potentially hazardous substances, such as explosives, “dirty” refers to solvent waste containing identified and labelled dissolved solids or hazardous materials. Categories (ii) to (v) must be labelled with type and volume and the label for category (iv) must include whatever information is available on dissolved solids. Toxic and hazardous materials must be rendered harmless by the individual before packaging into transport containers. All containers must be labelled as above and, in addition, carry the name(s) and signature(s) of those contributing to the contents. Wastes will be collected from each Department on the day it is sent to the Tip and Departments will be informed several days in advance of the collection date. A hazardous waste manifest will be obtained for each consignment by the Chemistry Department based on the registered content from each contributor. Note that flammable solvents cannot be sent to the Tip, these should be recovered, evaporated or incinerated. Wastes should be packed into metal or plastic containers with sufficient suitable absorbent packing to ensure safety in transit.

Maximum sealed container weight 20 kg.

a) Category (i), halogenated solvents, must be stored for future disposal or evaporated via a fume-hood.

b) Category (ii), water soluble solvents, as well as water soluble acids, bases and salts, may be diluted with water and flushed down the drain with running water. Only use a sink or drain which is connected directly to the external drain and label the area or sink as a waste disposal area. A sink on the sixth floor of a building, for example, would not be suitable. Care must be exercised so that reactive combinations are not flushed into the drains at the same time.

c) Category (iii), "clean" water insoluble solvents will be incinerated as soon as a University facility is operational, in the meantime, evaporation through a fumehood is allowed.

d) Category (iv), "dirty" water insoluble, may be evaporated to dryness in a fumehood and the solid residue sealed in labelled plastic drums. Alternatively, non-flammable "dirty" solvents may be packed into an absorbent material for disposal to the Tip.

e) Category (v), involatile liquids such as oils which cannot be recovered, must be absorbed into a suitable absorbent, such as vermiculite, packed and sealed into labelled plastic drums.

4. Water insoluble solids must be rendered safe to handle by packaging in vermiculite or mixed with harmless fillers and packaged into clearly labelled, sealed plastic drums. Different materials may be consolidated providing that chemical reactions cannot occur.

Waste Disposal

Reference Notes

1. TOXIC WASTE

1.1 Definition of Toxic Wastes

Any solid or liquid wastes which are poisonous, noxious or dangerous in significant quantity, but excluding radioactive wastes, natural organic wastes, household refuse and domestic sewage.

1.2 Sources of Toxic Wastes

Toxic wastes may originate from three general sources:

- (a) residues from manufacturing processes, synthesis in undergraduate or graduate laboratories;
- (b) old chemical stock;
- (c) materials accidentally spilt.

1.3 Principles of Toxic Wastes Control

- (a) It is the responsibility of the University in cooperation with the Christchurch City Council to deal with its own toxic wastes.
- (b) The re-use, or an alternative use, of unwanted chemicals should be considered as the first priority.
- (c) The toxic component(s) should be identified, for example "sludge", and be specified by the process from which it was formed, so that the toxic ingredients can be recognised.

- (d) Detoxification should be employed wherever it is practicable.
- (e) The regular deposition of large amounts of toxic wastes at refuse disposal sites is inadvisable and is discouraged by the Christchurch City Council. Suitable alternative methods of disposal should be considered.
- (f) In the event of spillage of toxic wastes, initial efforts should be made to contain the spillage rather than to clear it up. The University Safety Officer, Paul Perry (6936) should be notified immediately. If the Safety Officer is unavailable then contact Dr. Alan Happer (6438), Professor Peter Harland (6454), Laurie Anderson (6468) or Dave Morrison (6876), Chemistry Department. Out of hours emergencies should be directed to 6111 with a request for the Fire Service.

1.4 Methods of Disposal

(a) Disposal at Source

The possible methods of disposal at source are:

- (i) Discharge to the public sewerage system after neutralisation and dilution.
- (ii) Incineration
- (iii) Neutralisation and disposal with other non-toxic wastes at the City Tip (see (b)).

(b) Disposal to Controlled Public Tip

Suitable tips are designated by the local authorities for toxic waste disposal.

The disposal of waste materials to the tip will be coordinated and collected by the Chemistry Department. Individual departments must not take materials for disposal.

(c) Incineration

Disposal of toxic wastes by incineration must comply with the requirements of the Resource Management Act 1991. In every case it is important that sufficient temperature is maintained throughout to ensure complete combustion of the wastes and to avoid dispersal into the atmosphere of toxic residues. If in doubt, contact the University safety Officer, Paul Perry (6936) who will seek advice from the Regional Air Pollution Control Officer through the Regional Council.

1.5 Transport and Handling of Toxic Wastes

All drivers of vehicles carrying toxic materials or wastes should be aware of the nature and potential hazards of the material they are transporting. The Code of Practice for the Transport of Hazardous Substances on Land must be consulted. Any significant spillage should be notified immediately to the NZ Fire Service and access to the contaminated area prevented until advice has been obtained.

1.6 Central Consultant Service on Toxic Waste Disposal

Advice from the Chemistry Department (Dave Morrison (6876) and the following pages may be used to determine the preferred method of disposal. All materials for disposal must be identified and the name of the person providing the waste must be included on the label.

2. CONSIDERATION OF SOME SPECIFIC TOXIC WASTE PROBLEMS AND SUGGESTED METHODS OF DISPOSAL

2.1 General Notes

- (a) Special problems should be referred to the Chemistry Department via Mr Dave Morrison, 6876.
- (b) Disposal of untreated toxic wastes via sewers is generally inadvisable as it may result in damage to biological treatment processes in sewage treatment plants or may kill fish and other aquatic life in receiving waters. In every case, toxic waste disposal via public sewers must comply with local authority trade waste bylaws. Acids, bases, soluble salts and water soluble solvents may be diluted with water and committed to the drains.
- (c) Incineration is the best method of disposal of certain organic toxic wastes. It is essential that conditions of incineration satisfy the requirements of the Resource Management Act 1991, and in any case of doubt, the advice of the Regional Air Pollution Control Officer employed by the Canterbury Regional Council should be sought. A University facility will be available in the near future, in the meanwhile volatile, water insoluble solvents and mixtures may be evaporated through fumehoods.
- (d) The discharge of any wastes into natural waters is subject to the provisions of the Resource Management Act 1991, which requires the issue of a “right to discharge” by the Canterbury Regional Council.
- (e) Although there are relatively few limitations on the disposal of toxic wastes at sea, such activities are subject to the approval of the Marine Division of the Ministry of Transport. The International Convention on Ocean Dumping, to which New Zealand acceded in November 1972, strictly prohibits certain substances from ocean dumping and requires special precautions in the case of certain other substances.
- (f) An “approved” tip for toxic waste disposal will be designated by the Christchurch City Council for University waste disposal.
- (g) The difficulties of “tipping” or “burying” liquid toxic wastes suggest that those capable of pre-treatment or detoxification by neutralisation, precipitation or other chemical reaction may be disposed of better by discharging to sewers following separation of any solid toxic residue.

2.2 Particular Examples of Toxic Waste Disposal

The methods of disposal are listed in general order of preference.

Type of Toxic Waste

Special Considerations

Methods of Disposal

Acids

Corrosive properties

Neutralise with, for example, calcium carbonate before discharging into sewer.

Acid tars and highly acidic organic residues

Low solubility makes these suitable for burying.

Bury in an 'approved' tip.

Alcoholic waste

Liquid wastes should be in impervious containers before burying.

1. Incineration
2. Discharge of diluted waste to sewer.

Alkaloid wastes

Varying chemical nature. The toxic components should be identified.

1. Incineration
2. Bury in an 'approved' tip.

Aromatic hydrocarbons

The toxic components should be identified. Hazards may arise from toxicity, volatility, flammability, persistence or a combination of these factors.

1. Re-use
2. Incineration

Arsenic waste including sawdust and ash from arsenically treated timber

Being a heavy metal arsenic is particularly persistent and when choosing a disposal method much consideration must be given to possible long-term effects of accumulation. If possible soluble arsenic salts should be converted to insoluble salts (for example sulphides).

2. Re-use for example, ceramics or glass manufacturing industries.
3. Bury in an 'approved' tip (as in insoluble salt).
4. Incineration under controlled conditions at approved sites. Ash must still be disposed of at an 'approved' tip.

Beryllium wastes

Highly toxic. If burying convert to an insoluble salt (for example acetate hydroxide or oxide).

1. Re-use for example in glass industry, in alloys or as a catalyst for organic reactions.
2. Bury in containers in an 'approved' tip.

Carbides (acetylides)

Explosive hazard, sensitive to shock, friction and heat. Reacts violently with water.

Contact Explosives Branch of Department of Internal Affairs.

Chlorocresols and chlorphenols

Have bactericidal properties could be very hazardous if discharged into sewer.

Incineration

Chromic acid (chromium trioxide)

Powerful oxidiser: If in contact with combustible material it may cause fire.

Detoxify by converting to comparatively innocuous chromic salt. Re-use or bury in an 'approved' tip.

Cyanide wastes

High toxicity and volatility.

Detoxify with chlorine or hypochlorite. Discharge diluted waste to sewer.

Diaminodiphenyl-methane

1. Re-use, e.g. Dye industry.
2. Incineration
3. Bury in an 'approved' tip.

Fluorides

Inorganic fluorides are highly toxic and irritant.

1. Re-use, for example glass industry.
2. Bury as one of the less soluble salts if possible.

Lacquer

May contain lead acetate. If so, convert to less soluble sulphate before burying.

1. Incineration
2. Bury in a 'approved' tip.

Leaded petrol sludge

Bury in an 'approved' tip.

Lubricants

Considerable variation in types and formulations.

1. Re-use, e.g. as fuel.
2. Incineration

Mercaptans

When heated to decomposition they emit toxic fumes of SO₂/SO₃. Will react with water, steam or acids to produce toxic and flammable vapours. They can react with oxidising materials.

Vapours are particularly malodorous, for example, Parnell incident.

Incineration

Nicotine waste

Highly toxic. Must not be tipped into sewer.

1. Incineration
2. If possible destroy chemically before burying in an 'approved' tip.

Oil-impregnated rubbish

On no account dump at sea.

Bury in an 'approved' tip.

Oil waste

On no account dump at sea.

1. Re-use, e.g. as fuel in central heating unit.
2. Bury in an 'approved' tip.

Organic solvents

Highly volatile. Vapours may be flammable and toxic.

1. Redistil and re-use.
2. Incineration
3. Evaporation (until incinerator available)

Paint waste

1. Bury in an 'approved' tip.
2. Incineration

Pesticides or residues from pesticide formulations

Organochlorines must not be dumped at sea or discharged into sewer.

1. Incineration - Special care is required.
2. Bury in an 'approved' tip.

Plating sludges

May contain cyanides.

1. Detoxify with chlorine or hypochlorite.
2. Bury in an 'approved' tip.

Sludges containing copper, zinc, cadmium, nickel, or their compounds

Detoxify and restrict the spread of metals by converting soluble to insoluble salts.

Bury in an 'approved' tip.

Sodium acetylide

See "carbides"

Solid tarry matter

Bury in an 'approved' tip.

Sulphides

Heavy metal sulphides are generally insoluble and may be buried safely although there could be a slow release of hydrogen sulphide. The other sulphides may react violently with water or with oxidising agents. These should preferably be oxidised before burying.

1. Re-use if possible.
2. Bury in an 'approved' tip.

Tarry liquids

On no account dump at sea.

1. Incinerate
2. Bury in an 'approved' tip.

White spirit

Re-use in heating units for example would be too dangerous because of flash point.

1. Re-distil if in sizeable quantity.
2. Small quantities may be safely disposed of by evaporation.

Appendix B

Policy Statement on Occupational Health, Safety and Loss Control

Recommendations of the University Health and Safety Committee to the Vice Chancellor and the University Council

1. The University regards the promotion and maintenance of occupational health, safety and loss control as mutual objectives for everyone who works, studies, visits or has business on the university campus and field stations and University properties.
2. The University is dedicated to the provision of a safe and healthy working environment and to the conduct of all its activities in a safe manner to prevent harm to persons, damage to property or disruption to programmes and processes.
3. The University will do all that is reasonable and within its powers to:
 - a) provide and maintain a healthy and safe working environment;
 - b) provide training and instruction in occupational health and safety and loss control matters;
 - c) provide suitable safety devices and protective equipment to further these aims;
 - d) promote occupational health and safety standards
 - e) encourage participation in monitoring, improvement and promotion programmes established to enhance health and safety standards.
4. Staff, students and all persons who have business at the University are considered by the University to have a duty to co-operate in the maintenance of a safe and healthy environment at all times by:
 - a) working safely and effectively with due regard to the effects of their efforts on others;
 - b) adhering to statutory safety regulations, University rules and standard operating procedures;
 - c) using and maintaining all equipment and facilities provided in the correct manner and reporting any unsafe conditions or defects found immediately;
 - d) participating in health and safety programmes, through committee membership, courses of instruction and safety investigations and audits, if called upon to do so.
5. The University relies on Heads of Departments, Section Heads, Unit and Centre Supervisors and laboratory supervisors and others in positions of responsibility for vigilance, motivation and enforcement of safety and health practices and especially to be alert to the desires of those in their care for a safe work environment.
6. Safety and loss control demands an attitude, to be adopted by all, of total awareness, involvement and commitment in order to achieve excellence in this important area and the University believes that no other standard can be acceptable.

Professor P.W. Harland
Chairperson
Health and Safety Committee

Mr. Graham Hodgson
University Safety Officer

Professor Roy Sharp
Vice-Chancellor

Appendix C

Definitions

CARCINOGENIC

Refers to something that can cause cancer.

MUTAGENIC

Refers to something that induces genetic mutation.

Mutation is defined as

- i) A process by which a gene or some other DNA sequence undergoes a change in structure.
- ii) A gene or other DNA sequence that has undergone a structural change.
- iii) An individual that has undergone a mutational change and expresses this change in the phenotype.

TERATOGENIC

A substance or drug producing abnormal embryos ie tends towards teratogenesis.

Teratogenesis is defined as:

The development of an abnormal mass of cells composed of diverse, differentiated and undifferentiated cell types during foetal development, causing physical defects in the foetus.

Both mutagenic and teratogenic compounds have reproductive effects.

Appendix D

Hazardous Chemicals

A large number of chemical reagents and solvents are now known to be capable of causing cancer (carcinogens) or birth defects (mutagens). While a detailed list of such substances is available in the Chemistry Department, a summary of the more common compounds is listed below:

- Compounds of chromium (including dichromates), nickel, cadmium, cobalt, manganese and arsenic; lead acetate.
- Chlorinated hydrocarbons, e.g.
 - Carbon tetrachloride
 - Trichloroethylene
 - Chloroform
 - 1.1.2 Trichloroethane

[Note that while the solvent 1.1.1 Trichloroethane, known as 'chlorothene NU' or Genkalene', is **not** on the list, exposure to this material should in any case be kept to a minimum due to its chemical toxicity. This toxicity is however considerably less than that of other common chlorinated hydrocarbons such as carbon tetrachloride, which is particularly dangerous.]

- Benzene, aniline and aniline salts, formaldehyde ('formalin'), 'Rhodamine B' (a dye used in some dye lasers).
- Organic nitroso compounds and naphthylamines in particular should be handled with extreme care.

Persons using unfamiliar chemicals should remember that as well as checking for carcinogenic activity it is also wise to check the acute chemical toxicity of these in a reference book such as Sax '*Dangerous properties of Industrial Materials*' (copies in Room 613 just inside door on right and in the Physical Sciences Library). For example, cadmium compounds and carbon tetrachloride are both toxic as well as carcinogenic.

It is well to remember that cancer producing chemicals may be handled for many years without any symptoms appearing. The onset of the cancer may occur up to 20 years or more after the exposure to the chemical has occurred. It is important therefore not to become careless in the handling of carcinogenic chemicals.

Appendix E

Radiation Safety Plan

Sealed Radioactive Sources

Radiation Safety Policy

The Department of Physics and Astronomy will ensure, as far as reasonably possible, the health and safety of its employees, contractors working on the premises, and members of the public who may be exposed to the hazards arising from the use of sealed radioactive sources.

No staff member of the Department of Physics and Astronomy is permitted to use sealed radioactive sources unless they are so authorised in this *Radiation Safety Plan* and has signed the relevant entry to indicate familiarity with and acceptance of the requirements and procedures in this *Radiation Safety Plan*.

Responsibilities and Authorisations

Principal licensee

Overall responsibility for ensuring this *Radiation Safety Plan* is implemented and reviewed lies with the principle licensee for the Department of Physics and Astronomy.

<i>Name</i>	<i>License number</i>	<i>Position title</i>	<i>Signature</i>
Cliff Franklin	15986	Lab Supervisor	

Licensed users

The following licensed persons are authorised to use the sealed radioactive sources of the Department of Physics and Astronomy and are responsible for complying with the procedures in this *Radiation Safety Plan*.

<i>Name</i>	<i>License number</i>	<i>Position title</i>	<i>Signature</i>
Orlon Peterson	TBA	IT Supervisor	

Persons authorised by the principal licensee to use sealed radioactive sources under instruction

The following persons are authorised to use the sealed radioactive sources of the Department of Physics and Astronomy under the instructions of the principal licensee, and are responsible for complying with the procedures in this *Radiation Safety Plan*. They are authorised to act as the principal licensees delegate for the purpose of undergraduate laboratory supervision. These persons must receive training on the basic radiation protection requirements associated with the safe use of sealed radioactive sources before being so authorised.

Radiation Safety Audit Checklist

<i>Radiation Safety Plan</i>	<i>Complies</i>	<i>Notes</i>
Authorisations valid: Licensees Users under instruction		
Training records correct		
Sealed source register correct		
Local rules for the safe use of sealed radioactive sources are current		
Incidents / Accidents records		
Emergency procedures in place		
Hazard assessment current		
<i>Sealed Radioactive Source Store</i>		
Access controlled Keys issued to:		
Labelling		
<i>Sealed Radioactive Sources</i>		
All sources present and accounted for		
Use log		
Labelling		
Wipe tests done		
<i>Signed by the principal licensee</i>		
<i>Date of Audit</i>		

Incident and Accident Records

All incidents and accidents are to be recorded on an Incident Form available near the mail trays in room 711. The completed form is passed to the Department of Physics and Astronomy's Principal Licensee who notifies the Department of Physics and Astronomy's Safety Officer who in turn will notify the University of Canterbury's Safety Officer.

Local rules for the safe use of sealed radioactive sources

1. When not in use **ALL** sealed radioactive sources are to be stored securely in the Department of Physics and Astronomy's radioactive store, room 409.
2. Wipe tests are to be performed annually by the principal licensee on **ALL** sources with the exception of the Americium-241 smoke detector sources. The results are to be recorded in the wipe test log book. This book is kept in the radioactive store, room 409.
3. Sealed radioactive sources of a sufficient strength to be notified to NRL are to be issued only by the Department of Physics and Astronomy's Principal licensee. These sources are to be stored separately from the rest.
4. Other sources may be taken for use in lecture demonstrations and undergraduate laboratories by users authorised to act under instruction.
5. The issuing of **ALL** sources shall be recorded in the use log. This log is kept in the radioactive store, room 409.

6. When issued on long term loan to the teaching laboratories sources may be kept in secure storage associated with the laboratory. These sources **MUST** be returned to the main store at the end of each semester. The locations of all these storage areas to be detailed as part of this *Radiation Safety Plan*.
7. Sources will be issued to students under the supervision of users authorised to act under instruction. Records will be kept of which sources the students have been issued. The students will also receive some instruction in the safe use of these sources, these to form part of each laboratories instruction manual.
8. Where practical all sources are to be handled with tongs or other suitable tools.
9. In the event of any accident or emergency or loss of a sealed radioactive source the principal licensee Cliff Franklin must be contacted immediately. Phone ext. 7611. If the licensee cannot be contacted the University of Canterbury's Safety Officer Graham Hodgson should be contacted, phone ????, or advise sought from the National Radiation Laboratory.
10. If the principal licensee will be absent from the Department of Physics and Astronomy for an extended time, they may give a copy of the key to the secure store to one of the authorised users for the duration of their absence.

Specific rules for using source 21, Cesium-137

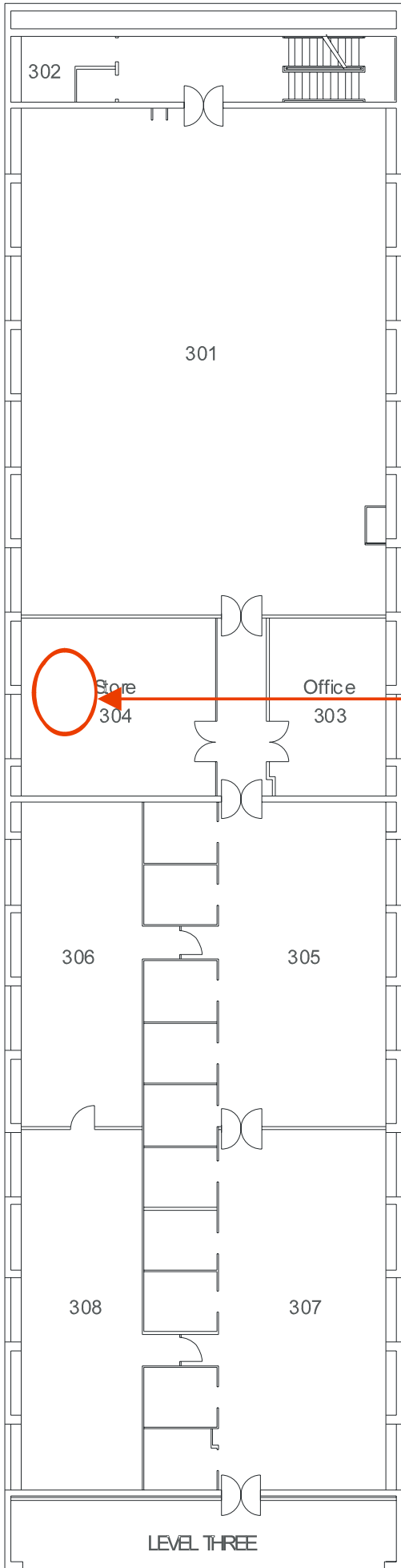
This source has a potentially high skin dose at the aperture of its containment vessel. To minimise the hazard to users the following rules are to be followed at all times.

1. Whenever not actively using the source the aperture shield is to remain in place.
2. All users are to take every precaution possible to keep themselves and other members of the public out of the beam of radiation when the front shield is removed.
3. No user is to attempt to open or modify the containment of this source without first consulting the Department of Physics and Astronomy's principal licensee.

Specific rules for using sources 45-1 to 45-9, Uranium-238

Due to the sensitive nature of these sources specific to their isotope they are notified to the International Atomic Energy Agency (IAEA). This means extra precautions are required to prevent their loss. The following rules are to be followed at all times.

1. These sources will only be issued by the principal licensee, and only to *Authorised Users*.
2. At no time are these sources to be left unsupervised by the licensee or the *Authorised User* they are issued to.
3. They are only to be issued for the exact duration required, and not for long-term loan.



Storage location during term

