Report of the

Radiological Council of Western Australia

for the year ended

31 December 2009

REPORT OF THE

RADIOLOGICAL COUNCIL

for the year ended

31 December 2009

TABLE OF CONTENTS

CHAIRMAN'S REVIEW I

RADIATION SAFETY ACT 1975 – 2009 4

STATUTORY RESPONSIBILITIES OF THE COUNCIL 4

MEMBERSHIP OF THE COUNCIL 4

ADVISORY COMMITTEES 5

ADMINISTRATIVE SUPPORT 5

STATE ELECTORAL ACT 6

STATE RECORDS ACT 6

THE RADIOLOGICAL COUNCIL WEBSITE 6

REGISTRATIONS, LICENCES AND TEMPORARY PERMITS 6

QUALIFICATIONS AND TRAINING OF RADIATION USERS 6

CHANGES TO LEGISLATION 6

RADIATION INCIDENTS 7

PROSECUTIONS 12

MEDICAL AND RELATED RADIATION MATTERS 13

- Compliance Testing 13
- Approvals for Exposure to Radiation for Human Subjects in Medical Research 13

INDUSTRIAL, ENVIRONMENTAL AND MINING RADIATION 15

- Industrial Compliance Testing 15
- Standards for Council Examinations 15
- Uranium Mining 15

MISCELLANEOUS 16

Security of Radioactive Sources 16

Radiation Health Committee 16

National Directory for Radiation Protection 17

Personal Radiation Monitoring Services 17

APPENDIX 1: REGISTRATION AND LICENSING 18

APPENDIX 2: LICENCE PREREQUISITES 20

ATTACHMENT 1: RADIOLOGICAL COUNCIL 21

ATTACHMENT 2: LEGISLATION AMENDMENTS 23

ATTACHMENT 3: COMPLIANCE TESTING 24

ATTACHMENT 4: INDUSTRIAL RADIATION SAFETY EXAMINATIONS 25

ATTACHMENT 5: LIST OF AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY PUBLICATIONS FOR 2009 26

ATTACHMENT 6: REGISTERED IRRADIATING APPARATUS, ELECTRONIC PRODUCTS AND RADIOACTIVE SUBSTANCES (SEALED SOURCES) 27

ATTACHMENT 7: LICENCES AND REGISTRATIONS 29

ABBREVIATIONS 36

CHAIRMAN'S REVIEW

This is the first Annual report that I have had the pleasure of presenting since my appointment as Chairman of the Radiological Council in June 2009.

I was very fortunate to have taken over the Council from Dr Paul Psaila-Savona, who had been the Chairman for the previous 9 years and had overseen a wide range of initiatives, including the introduction of the compulsory compliance testing of medical, dental and chiropractic diagnostic x-ray equipment; the approval of new imaging and therapeutic modalities, such as High Dose Rate Brachytherapy and Positron Emission Therapy (PET); the licensing of Medical Radiation Technologists under the *Radiation Safety Act 1975*; and the commissioning of the Cyclotron.

This year, as in previous years, the Council has dealt with a number of very important issues that are described more fully in the body of this report. Of particular note was the recommencement of uranium mining exploration and radiation security issues.

On 17 November 2008, the State Government officially overturned a ban on uranium mining in Western Australia. Uranium mining and processing, certain exploration activities and the transport of uranium ore are subject to the *Radiation Safety Act 1975* and any subsidiary legislation.

The Council has an independent role in ensuring the appropriate oversight of the radiation safety aspects of uranium mining and this includes:

- the review of radiation management plans;
- approvals of radiation safety officers;
- the review of occupational and environmental reports;
- conducting independent monitoring and surveillance; and
- conducting inspections and audits.

In 2009, the Council was made aware of twenty six uranium exploration projects, with three companies already indicating their intent to advance their uranium mining projects in Western Australia. The Council has been integrally involved in the review of the Radiation Management Plans, and the radiation safety assessment of these projects, and this is anticipated to continue to be a major feature of 2010, as a number of these projects move towards production.

The *Code of Practice for Security of Radioactive Sources* (Security Code) was published in 2007 by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), with the expectation that this would be progressively implemented nationally.

Legal advice indicated that, while complete implementation of the Code would require amendments to the Radiation Safety Act, the required physical and procedural security measures lay within the scope of the current Act.

From the 1 July 2009, conditions were placed on the owners of security enhanced sources to comply with the relevant provisions of the Security Code, as it applies to physical and procedural security measures. Owners of security enhanced sources are now also required to submit a source security plan.

There were 13 radiation incidents reported to the Council in 2009. While the majority of incidents reported have been relatively minor, the Council continues to monitor incidents to ensure that public safety is not compromised and expresses appropriate concern as necessary. In this regard, the Council keeps itself informed of best international practice in radiation safety and has reviewed a range of reports dealing with regulatory developments.

The Council has continued to carry out efficiently its day to day responsibilities of licensing and registration of premises, equipment and persons; of providing professional advice to Government and the Minister of Health on all radiation health issues; the investigation of medical radiation incidents; the management of industrial, environmental and mining radiation incidents; and the upgrade of radiation safety legislation to keep up with the times.

The difficulties of recruiting staff eased in 2009, partially due to the financial downturn, but the increased workload faced by the staff of the Radiation Health Branch observed and referred to in the previous few years reports continued in 2009. This remains of concern to the Council. As was discussed last year, the number and complexity of irradiating apparata and radioactive substances used, and regulated, under the Act continue to grow, as does the requirement to support

uranium mining, and this relentless growth places considerable pressure on the officers of the Branch. I once again wish to thank them for their efforts in guarding the safety of people of Western Australia from the detrimental effects of ionising radiation.

Finally I wish to thank all members of the Council for their support, particularly in my role as the new Chairman; continued contributions in and out of sessions, and sheer hard work during 2009. Their individual strengths and expertise, together with the assistance of officers of the Radiation Health Branch, permit the Council to fulfil its statutory function smoothly.

Dr Andy Robertson
CHAIRMAN

30 March 2010

RADIATION SAFETY ACT 1975 – 2009

STATUTORY RESPONSIBILITIES OF THE COUNCIL

The Radiological Council is appointed under Section 13 of the Radiation Safety Act to assist the Minister to protect public health and to maintain safe practices in the use of radiation.

In its position as an independent regulatory authority, the Council is required to administer the Act and to —

- implement the scheme of licensing and registration;
- conduct inquiries into alleged contraventions of the Act and, where necessary, to suspend or cancel licences and registrations;
- advise the Minister and make recommendations with respect to the technical aspects of radiation safety requirements, the methods that may be used to prevent or minimise the dangers arising from the use of radioactive substances, irradiating apparatus and electronic products, including the preparation of regulations;
- investigate and prosecute offences.

The Council is also required to keep under review manufactured or assembled devices which emit radiation to determine if control of these devices is necessary under the Act.

Section 10 requires the Minister at all times to have regard to the expressed views of the Council.

MEMBERSHIP OF THE COUNCIL

The Council comprises —

- a medical practitioner appointed by the Governor on the recommendation of the Executive Director Public Health;
- a medical practitioner who is a specialist in radiology or radiotherapy;
- a physician specialising in nuclear medicine;
- a person who possesses relevant qualifications or experience as a physicist;
- a person who possesses relevant qualifications or experience as a radiation engineer or electronic engineer;

- a representative of the interests of tertiary educational institutions.
- two other persons with special expertise in radiation protection may be nominated by the Minister on the advice of the other members of the Council.
- a medical radiation technologist.

The present members, approved by the Governor, are listed in attachment 1.

The Council met six times in 2009.

ADVISORY COMMITTEES

The Council may appoint committees under Section 19 of the Act to investigate and advise on any aspect of its functions, or to carry out any function other than those relating to licences and registrations. The present policy is to create, when necessary, short-term working parties which address a specific issue and report back to the Council.

The only exception is Council's Chiropractic Advisory Committee which is appointed to supervise the radiation safety examination for chiropractors who wish to apply for licences to operate diagnostic x-ray equipment. The committee, which also advises Council on other chiropractic matters, met twice in 2009.

ADMINISTRATIVE SUPPORT

Section 10(4) of the Act provides for the administration of the Act to be paid out of moneys appropriated by Parliament for the purpose. However, the Council is not funded directly and relies on the Department of Health's Radiation Health Branch for administrative and scientific support. While the greater part of the Branch's duties are directly concerned with supporting the Council's needs, and many of the staff are appointed authorised officers under Section 4(1) of the Act for this purpose, the Branch also provides separate advice to the Department on a range of radiation issues.

The Radiation Health Branch also provides the Secretary of the Council. The position has been held by Ms H Upton (Managing Health Physicist) since February 2002, with Mr L Dahlskog (Senior Health Physicist) or Mrs M Aerts (Health Physicist) performing these duties in Ms Upton's absence.

STATE ELECTORAL ACT

For the purposes of Section 175ZE of the State Electoral Act, the Radiological Council has no expenditure to report. Council's functions are supported from within the budget assigned by the Department of Health to the Radiation Health Branch. The Council does not have a budget in its own right.

STATE RECORDS ACT

The Radiological Council's record keeping systems are managed by the Radiation Health Branch of the Department of Health, and thus the Council's compliance with the State Records Commission Standard 2, Principle 6 is linked to compliance by the Department of Health.

THE RADIOLOGICAL COUNCIL WEBSITE

In 2004 the first version of the Radiological Council Website was finalised and was made available for access by the public at the address www.radiologicalcouncil.wa.gov.au. There were no amendments made to the website during 2009; although, due to feedback from users of the site amendments are being drafted.

REGISTRATIONS, LICENCES AND TEMPORARY PERMITS

Registration and licensing are the principal means by which the use of radiation is regulated. A summary of the legislative system for registration and licensing in Western Australia is included in appendix 1.

QUALIFICATIONS AND TRAINING OF RADIATION USERS

A summary of the legislative scheme for ensuring the appropriate qualifications and competence of persons applying for licences is included in appendix 2.

CHANGES TO LEGISLATION

Amendments made to the Act and Regulations in 2009 are listed in attachment 2.

RADIATION INCIDENTS

Reported incidents involving radiation rarely pose a major health risk to the individuals exposed. Regulation 19A of the Radiation Safety (General) Regulations requires registrants to notify the Council in writing and as soon as practicable should any of the abnormal or unplanned radiation exposures specified in that regulation occur.

Although there is no certainty that all incidents are reported, Council encourages reporting and rigorous investigation of the cause as this provides a forum for improving work practices and minimising the risk of recurrence of such incidents.

The Council was notified of 13 incidents during 2009.

Medical Incidents

- Council was advised by the Radiation Safety Officer of a hospital of a misadministration incident. The incident had occurred when a diagnostic radiopharmaceutical ^{99m}Tc labelled compound was inadvertently tissued in the patient.

  Radiation dose calculations indicated the patient received an additional effective dose of 4.55 mSv since the diagnostic study needed to be repeated correctly.

  Council noted the statements in the Radiation Safety Officer's report that all reasonable steps had been taken to ensure adequate operation of the apparatus (including flushing of the cannula after each insertion and immediately before administration of the tracer) and that it was only during the last flush that there was any evidence of extravasation. Council accepted the conclusion that there were no additional precautionary measures that could have been taken in this particular case or in the prevention of future occurrences.

- A misadministration incident of a diagnostic radiopharmaceutical to the wrong patient occurred in the Nuclear Medicine Department of a hospital when a child of just under 12 months was inadvertently given a 230 MBq ^{99m}Tc labelled bone scan dose intended for another patient instead of the requested ^{123}I compound. The radiation dose estimation indicated the child received an additional effective dose of 6.2 mSv.

  In accordance with the Radiation Safety (General) Regulations, the Radiation Safety Officer of the hospital informed the Radiological Council of the matter and of the medical response and future preventative measures. Reports were also received from the responsible technologist and nuclear medicine specialist doctor.

The error occurred because the identity of the presented patient (who was of similar age and size to the summoned patient) was not confirmed by the technologist administering the radiopharmaceutical. Encouragement of oral hydration of the child was directed by the nuclear medicine specialist, who was not on-site at the time of the incident but was immediately advised, and who discussed the incident with the mother and also subsequently proceeded with the scheduled study.

Council wrote letters to the Registrant (the Hospital), with copies to the Radiation Safety Officer and Radiation Safety Committee, recording its concern and requiring a review of the procedural policies. The policies for administration of radiopharmaceuticals were thoroughly reviewed by the Hospital with particular emphasis on the principle of the person administering any medical procedure being responsible for requesting identification from the patient (or guardian) immediately before proceeding.

Council was satisfied with the review of procedures and protocols that had been conducted and implemented by the hospital.

- An inadvertent disposal of radioactive waste bags amongst the non-radioactive waste occurred from a laboratory in the Nuclear Medicine Department of a hospital.

  In accordance with the Radiation Safety (General) Regulations, the Radiation Safety Officer of the hospital informed the Radiological Council of the matter and response taken.

  The incident occurred because a new and insufficiently-instructed cleaner accessed a restricted laboratory area and inadvertently removed bags that were awaiting disposal/storage as appropriate for low level radioactive waste. The bags were sent to the same disposal site that is approved for supervised low-level radioactive waste but were incorrectly sent as non-radioactive waste.

  The contents of all bags would have contained a number of radioactive stickers. The contents of three of the bags contained negligible radioactivity, whilst the fourth bag contained ^{131}I with estimated activity less than 17 MBq. The burial package limit for ^{131}I for supervised landfill burial is 9.1 MBq and the Exempt Quantity given in Schedule V of the Radiation Safety (General) Regulations is 0.04 MBq. This bag of waste would have reached the Schedule V Exempt Quantity level in approximately 2 months.

  Council endorsed measures by the hospital to ensure prevention of future occurrences which included arrangements with the housekeeping department, laboratory protocols amended to ensure instruction of future cleaners, and locking of the laboratory door when unattended.

- An incident where ^{131}I-contaminated wastewater was released directly to the sewer occurred during the first part of an in-patient treatment when the switching of the delay-and-decay tanks was overlooked. The incident was advised to the Council by the Radiation Safety Officer.

  An estimated maximum of 2.97 GBq was inadvertently released directly to the sewer in a 27 hour period. Activity data from earlier periods indicated that the annual activity discharge limit of 4 GBq for ^{131}I for the hospital would be unlikely to be exceeded.

  Council required that the measures taken by the hospital to prevent future inadvertent releases of contaminated wastewater (including two persons to sign off on the switching of the iodine suite plumbing at the commencement of the patient treatment) were written into standard protocols.

- An incident of inadvertent radiation exposure of a non-radiation staff member occurred in a radiotherapy suite in a hospital, and was recorded in the Annual Report of 2008.

  During urgent evening maintenance work being carried out in a radiotherapy suite on a linear accelerator (Linac) by radiotherapy service personnel, operation of the Linac in electron mode was commenced while a relief cleaner was within the maze of the treatment room.

  In accordance with the Radiation Safety (General) Regulations, the Radiation Safety Officer of the hospital promptly informed the Radiological Council of the matter and response taken.

  The initial report estimated the doses to the cleaner as 65 µGy skin dose and a 1.5cm depth dose of 40 µGy, but subsequent physics assessment indicated it was likely to have been considerably less and close to background levels at the cleaner's position.

  The report recognised the potential of the situation for much more serious inadvertent radiation exposures, and outlined proposed changes to both physical positions and operational procedures for the interlock buttons that control the Beam-On and operator-acknowledgement of a cleared Linac room. The procedural amendments were implemented by the facility immediately, and a subsequent report confirmed completion of the structural modifications.

  Ongoing review by Council of the potential for such incidents in other Linac suites is continuing along with a review of staff training and access to restricted areas.

- Unusually high extremity doses for a month were recorded on the finger dosimeters worn by two persons involved with calibration of air monitors for the Cyclotron stack in a hospital, namely 132 mSv and 284 mSv to the left and right fingers respectively for the first person and 44 mSv to the left finger for the second person. (The extremity dose limit is 500 mSv per annum). The whole body TLD readings and electronic dosimeter readings were within the normal range.

  The reports from the Radiation Safety Officer to the Radiological Council detailed the investigation into the possible causes, demonstrating that significant exposures from the positron component would have been received to the hands (but not to other shielded parts of the body) during the new one-off procedures with ^{11}C in a hotcell.

  Council noted the proposals to restrict the type of radiation work over the next year for the receiver of the higher finger doses and to continue close monitoring of the finger doses of both staff members particularly if future similar work is undertaken.

- A reportable dose of 5.5 mSv for a 3 month period was recorded on the personal radiation monitoring TLD dosimeter worn on the trunk of a laboratory worker. This person was using low levels of the radioisotope ^{125}I while working alongside colleagues performing similar work where external dose rates would be expected to be extremely low.

  In accordance with the Radiation Safety (General) Regulations, the Radiation Safety Officer informed the Radiological Council of the matter and the response taken.

  Investigations, which included electronic dosimeter and thyroid monitoring, concluded that it was unlikely that the person had received the 5.5 mSv dose although no apparent cause of the recorded dose was found.

  Council asked for routine thyroid checks and wipe tests of the laboratory to be re-emphasised by the department.

- Two staff members (a nurse and a radiation therapist) were briefly exposed for about 10 seconds to x-ray scatter inside a Planning CT room in a radiotherapy facility. The incident was due to incorrect selection of the non-delay scanning option. A more experienced radiation therapist noticed the situation and terminated the exposure.

  The doses were estimated at less than 0.5mSv, thus not in themselves reportable. The facility nevertheless reported the incident to the Radiological Council, and the personal radiation monitoring dosimeters subsequently confirmed that the doses were less than 0.5mSv.

The report stated that installation of a door interlock was considered but rejected as this would prevent use of the contrast option; it was therefore proposed to use a "2 person select and check" procedure with training in this policy to all relevant staff. Council was satisfied that the policy amendments made to prevent a future occurrence were acceptable.

Industrial Incidents

- An Industrial Radiography company notified the Radiological Council on three occasions of apparent contamination within their industrial radiography equipment. While performing maintenance on the guide tubes, a company technician had observed readings ranging up to 1000 µSv/h on contact with the tubes.

  The company performed remote video inspection of the source holders which appeared to indicate that the sources were intact. Portable gamma spectroscopy equipment indicated the contaminant was Iridium-192, which was the source material used for the radiography. It was estimated that the contamination was well in excess of the internationally accepted standard of 185 Bq of removable contamination on the exterior of the source capsule.

  Any additional exposure to workers was unknown, though the measured dose rates were a maximum of approximately 1.6 µSv/h at 1 m.

  In all three incidents an Australian import agent had sourced the industrial radiography encapsulated iridium-192 sources from an overseas supplier. Further information provided from the overseas supplier regarding the possible causes indicated that the contamination stems from the hot-cells used in the production of the gamma radiography source holders.

  The industrial radiography companies in Western Australia that may have received radioisotopes from the supplier were contacted and advised of this incident. The Australian importer, other Australian regulators and the regulatory authority in the country of the overseas supplier were notified.

- Council was advised by a bore hole logging company that a 2.2 GBq ^{60}Co density logging source was lost down a drill hole.

  The logging tool containing the source had become trapped and the wire-line sheared through a designed weak point allowing the source to fall to the bottom of the hole. The logging company later advised it had successfully recovered the source undamaged.

- Council was advised by the radiation safety officer of a borehole logging company that two of their ^{60}Co sources in tools had became stuck in drill holes at two separate locations.

- Council was advised by a Registrant of a borehole logging company that a 3.7 GBq ^{137}Cs logging source had fallen to the bottom of a 15m deep drill hole and had been later recovered.

  The last two incidents occurred at the end of 2009 and further reports were still being completed.

Miscellaneous incident

- An institution of higher education notified the Radiological Council of seven missing radioactive demonstration sources. The loss was discovered when a newly appointed Radiation Safety Officer performed an audit of the radioactive material inventory.

  The missing sources and their original nominal activities were: ^{133}Ba 20kBq, ^{14}C 0.5kBq, ^{57}Co 40kBq, ^{60}Co 20kBq, ^{60}Co 240 kBq, ^{137}Cs 20kBq, ^{3}H 1.7kBq.

  However all sources were below, or were close to below the relevant quantity given in Schedule V Exempt quantity of radioactive substances of the Radiation Safety (General) Regulations.

  Council wrote to the Registrant with a reminder of the Registrant's responsibilities under the Radiation Safety Act and Regulations.

PROSECUTIONS

The following matter was finalised in 2009.

- Council initiated a prosecution against a dentist under Section 52 (2) of the Act for the alleged continuing offence of failing to register dental x-ray equipment. Section 52(2) of the Act requires a person who, when required to do so under this Act, fails to furnish within a reasonable time thereafter any information which the Council or an authorised officer has asked for in relation to any matter, or furnishes false or misleading information, commits an offence.

  On 26 June 2009 the matter was brought before a Magistrates Court and the accused was convicted. The dentist was fined $250 and charged costs of $571.70.

MEDICAL AND RELATED RADIATION MATTERS

Compliance Testing

Council's compliance testing program, which commenced in 1997, applies to all diagnostic x-ray equipment used on living humans for medical radiography, fluoroscopy, chiropractic radiography, dental radiography and computed tomography.

No x-ray equipment may be used for human diagnostic purposes unless it has a current certificate of compliance, a certificate of conditional compliance, or an exemption from compliance.

Through conditions imposed on the registration under Section 36 of the Act, the registrant (the owner) is legally responsible for satisfying the requirements of the compliance testing program.

The number of compliance tests of diagnostic x-ray equipment received by Council in 2009 was 1200. A summary of the statistics for the compliance program per type of diagnostic medical imaging equipment is included in attachment 3.

Approvals for Exposure to Radiation for Human Subjects in Medical Research

In Western Australia, all research projects involving exposure of human participants to ionising radiation must be evaluated by the radiation safety officer. When the level of radiation dose involved exceeds certain levels, Radiological Council approval must be obtained.

In keeping with the Australian Radiation Protection and Nuclear Safety Agency Radiation Protection Series # 8 (2005) *Exposure of Humans to Ionizing Radiation for Research Purposes,* the Council assesses research projects which involve exposing humans to ionising radiation without proven benefits to the irradiated subjects and where the dose to any individual adult subject exceeds 5 mSv in any year.

Council assessed and approved the radiation component of the following research applications in 2009.

Research Project Title	Institution
Cluster Hole versus Solid Cup Fixation in Total Hip Arthroplasty.	Sir Charles Gairdner Hospital
Characterisation of Global and Regional Hypoxia in Mesothelioma using ^{18}F-FMISO PET Imaging	Sir Charles Gairdner Hospital
Detection of Hypoxia by ^{18}F-flouromisonidazole (^{18}F-FMISO) in Suspected or Proven Pancreatic Cancer	Sir Charles Gairdner Hospital
Corevalve International Revalving Trial: Percutaneous Aortic Valve Replacement (PAVR) with the Corevalve Revalving System	Sir Charles Gairdner Hospital
Adjuvant Immunotherapy with Anti-CTLA-4 Monoclonal Antibody (Ipilimumab) versus Placebo after Complete Resection of High-Risk Stage III Melanoma	Sir Charles Gairdner Hospital
CD-40 activating antibody (CP-870,893) in combination with cisplatin and pemetrexed in unresectable malignant mesothelioma: a phase Ib study	Sir Charles Gairdner Hospital
ABRAXIS Protocol CA046 – A randomised Phase III study of weekly ABI-007 plus Gemcitabine versus Gemcitabine alone in patients with metastatic adenocarcinoma of the pancreas	Sir Charles Gairdner Hospital
GSK Protocol BRF112680 – A Phase I, open-label, multi-dose, dose-escalation study to investigate the safety, pharmacokinetics and pharmacodynamics of the BRAF inhibitor GSK2118436 in subjects with solid tumours	Sir Charles Gairdner Hospital
A Non-Randomised Study to Evaluate the Safety and Performance of the Portaero Pnuemostoma System on Patients with Severe Emphysema and Hyperinflation of the Lung.	Sir Charles Gairdner Hospital
Randomised Trial of Genetic Testing and Targeted Zoledronic acid Therapy to Prevent SQSTM1 Mediated Paget's Disease (Zoledronate in the Prevention of Paget's.	Sir Charles Gairdner Hospital
C-11 Methionine and F-18 Fluorothymidine PET imaging in suspected residual or recurrent glioma.	Sir Charles Gairdner Hospital
A Phase 3, Randomised, Double-Blind Placebo-Controlled, Multi-Center, Parallel-Group, Event-Driven Study to Evaluate the Efficacy and Safety of Ambrisentan in Subjects with Early Idiopathic Pulmonary Fibrosis	Royal Perth Hospital

INDUSTRIAL, ENVIRONMENTAL and MINING RADIATION

Industrial Compliance Testing

The Council's compliance testing program for fixed radiation gauges commenced in 1999. The program requires that gauges are not used unless they have a current certificate of compliance. The number of compliance tests received by the Council in 2009 was 820. A summary of compliance tests assessed in 2009 is included in attachment 3.

Standards for Council Examinations

Council had previously agreed that improved control over industrial radiation safety examination standards was necessary and had decided that while course providers may continue to invigilate examinations, all industrial papers would be returned to Council's officers for marking. The program commenced during the last quarter of 2002. In 2009, Council officers marked 488 industrial examination papers. The number of exams marked in each category is listed in attachment 4.

Uranium Mining

On 17 November 2008, the State Government officially overturned a ban on uranium mining in Western Australia. Uranium mining and processing, certain exploration activities and the transport of uranium ore are subject to the Radiation Safety Act and any subsidiary legislation.

Authorised officers of the Council participated in a working group with the Department of Mines and Petroleum, Department of State Development and the Department of Environment and Conservation to review the regulatory adequacy for uranium mining development in Western Australia. The working group noted that, with some minor changes, Western Australia's legislation and guidelines provide for the regulation of uranium exploration and mining consistent with world best practice in health, safety and environmental standards. New administrative agreements would also improve the level of coordination of the regulatory approval processes for uranium mining development.

The Council has an independent role to ensure the appropriate oversight of the radiation safety aspects of uranium mining and this includes –

- the review of radiation management plans;
- approvals of radiation safety officers;
- the review of occupational and environmental reports;
- conducting independent monitoring and surveillance; and
- conducting inspections and audits.

In 2009, the Council was made aware of twenty six uranium exploration projects. Three companies have already indicated their intention to advance their uranium mining projects in Western Australia.

MISCELLANEOUS

Security of Radioactive Sources

The *Code of Practice for Security of Radioactive Sources* was published in 2007 by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

Legal advice was sought from the State Solicitor's Office concerning the implementation of the Code. That advice indicated that complete implementation of the Code would require amendments to the Act to permit measures to be taken for the purpose of national security, as preventing terrorist attacks was not something contemplated when the current Radiation Safety Act was being drafted. The advice was that requiring physical and procedural security measures lies within the scope of the current Radiation Safety Act, whilst some other requirements of the security Code did not.

From the 1 July 2009 conditions were placed on the owners of security enhanced sources to comply with the relevant provisions of the Security Code as it applies to physical and procedural security measures. Owners of security enhanced sources are also required to submit a source security plan.

Radiation Health Committee

The Radiation Health Committee is a body established to advise the Chief Executive Officer of the Australian Radiation Protection and Nuclear Safety Agency and its Radiation Health & Safety Advisory Council on matters relating to radiation protection, formulating draft national policies, codes and standards for consideration by the Commonwealth, States and Territories.

Western Australia has representation on the Radiation Health Committee through the Secretary of the Radiological Council who attends the committee meetings tri-monthly.

A list of publications for 2009 is in attachment 5.

National Directory for Radiation Protection

At the Australian Health Ministers' Conference (AHMC) held in June 2004, the Ministers endorsed the adoption of the National Directory for Radiation Protection, Edition 1, as the Framework for National Uniformity in Radiation Protection.

Further development of the National Directory continued in 2009 through the national Radiation Health Committee, with a number of amendments being endorsed by Ministers in 2009.

Council continued its participation in the development of the National Directory and provided comment to the Radiation Health Committee.

Personal Radiation Monitoring Services

Council currently recognises six organisations for the provision of a personal radiation monitoring service in accordance with the Regulations:

- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the Commonwealth Government's radiation safety agency in Victoria.
- New Zealand National Radiation Laboratory, the New Zealand national radiation safety organisation
  (Australian agent: Australia Radiation Services Pty Ltd, Victoria).
- Australia Radiation Services Pty Ltd, a company based in Victoria.
- Landauer Inc (USA) for the Luxel based system.
  (Agent: Landauer Australasia Pty Ltd.)
- Global Dosimetry Solutions, a company based in USA.
- Global Medical Solutions Australia, a company based in NSW.

Appendix 1: Registration and Licensing

Registrations

Section 28 of the Act requires prescribed radioactive substances, x-ray equipment and electronic products, together with the associated premises, to be registered. Registrants may include individuals, companies, organisations or institutions.

All x-ray equipment is prescribed while prescribed electronic products include lasers, transilluminators and microwave ovens.

Radioactive substances that exceed the exempt quantities prescribed in the regulations are subject to registration. A small number of devices containing radioactive substances in excess of the exempt limits, but which pose a minimal hazard to users, have been exempted by regulation from control under the Act.

The numbers of devices and sealed radiation sources registered as at 31 December 2009 are included in attachment 6.

Licences

Section 25 of the Act requires persons who manufacture, store, transport, sell, possess, install, service, maintain, repair, use, operate or otherwise deal with prescribed radioactive substances, x-ray equipment or electronic products to be licensed or, where permitted, work under the direction and supervision of a licensee.

Section 29 of the Act also creates an offence for a person to sell any prescribed substances or devices unless they require the purchaser to produce evidence that they hold a relevant licence or are otherwise exempted by the Act or regulations. Sales also must be notified in writing to the Council, without delay, identifying the purchaser and the particulars of the relevant licence or exemption.

Exemptions from Licence

A licence is not required where a general exemption is provided by the regulations or where a person has been granted an individual exemption from licence. Although exempt from licensing, the regulations nevertheless specify the minimum qualifications or training required for these radiation workers.

Temporary Permits

The shortest period for which a licence or registration can be granted is 12 months. However, for shorter periods an application may be made for a Temporary Permit. Permits cannot exceed a duration of 3 months. Fourteen Temporary Permits were current as at 31 December 2009.

Conditions, Restrictions and Limitations

A range of performance and safety requirements for radioactive substances, x-ray equipment and the prescribed electronic products are specified in the regulations. However, additional safety measures may be applied by the Council under Section 36 of the Act through conditions, restrictions and limitations applied to registrations, licences, temporary permits and exemptions.

Failure to comply with a condition is an offence.

Attachment 7 shows the types and numbers of licences and registrations (or individual exemptions) granted or renewed in 2009.

Commonwealth Government Agencies and Contractors

The Radiation Safety Act does not apply to Commonwealth agencies or to their employees (or contractors) who might use radiation in Western Australia. Those agencies are regulated by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) under the Commonwealth Government's Australian Radiation Protection and Nuclear Safety Act 1999.

Appendix 2: Licence Prerequisites

Before a licence may be granted, the Council has an obligation to ensure that an applicant has appropriate qualifications, competence and experience (Section 33).

Protocols have been developed which prescribe the prerequisite qualifications and experience necessary for a wide range of radiation uses. Some qualifications are recognised by the Council because an appropriate degree of radiation safety training is inherent in gaining those qualifications. However, other applicants may be required to attend a recognised radiation safety course and pass an examination. The Council has authority to impose examinations under the Radiation Safety (Qualifications) Regulations.

Persons who are not required to hold a licence themselves but who must work under the direction and supervision of a licensee may also be required to hold certain qualifications or to have undergone additional radiation safety training. These requirements may be imposed by regulation or through conditions, restrictions and limitations imposed under Section 36. The registrant for the premises where the individual works is primarily responsible for ensuring compliance with these criteria.

Courses in various aspects of radiation safety are offered by both the government and private sectors, for example:

Bone Densitometry
Compliance Testing of Diagnostic X-ray Equipment
Fluoroscopy – Medical
Fixed Radioactive Gauges
Industrial Radiography
Lasers – Medical and Industrial
Portable Radioactive Gauges
Transport of Radioactive Substances
Unsealed Radioisotope Handling
Well (Borehole) Logging
X-ray Operator

Attachment 1: Radiological Council

MEMBERS OF THE 11TH RADIOLOGICAL COUNCIL

Members	Qualification or Designation	Deputy
Appointment under Sections 13(2)(a) and 13(3) of the Act		
Dr P Psaila-Savona (Chairman)	Medical Practitioner	Dr G Groom
Appointment under Sections 13(2)(b), 15(1) and 17 (1) of the Act		
Dr M Bennett[1]	Radiologist	Dr Deepthi Dissanayake
Dr G Groom	Nuclear Medicine Physician	Dr G Bower
Dr R Fox	Physicist	Dr R Price
Mr M Ross[2]	Electronic Engineer	Mr J O'Donnell
Prof J McKay	Tertiary Institutions representative	Dr Stephen Hinckley
Mr N Tsurikov	Expert in Mining Radiation Hazards	Mr G Fee
Mr N Hicks	Expert in Medical Imaging	Mr B Stock
Mr B Cobb	Co-opted member	not applicable

MEMBERS OF THE 12TH RADIOLOGICAL COUNCIL

Members	Qualification or Designation	Deputy
Appointment under Sections 13(2)(a) and 13(3) of the Act		
Dr A Robertson (Chairman)	Medical Practitioner	Dr G Groom
Appointment under Sections 13(2)(b), 15(1) and 17 (1) of the Act		
Dr M Bennett	Radiologist	Dr Deepthi Dissanayake
Dr G Groom	Nuclear Medicine Physician	Dr G Bower
Dr R Fox	Physicist	Dr R Price
Mr M Ross	Electronic Engineer	Mr J O'Donnell
Prof J McKay	Tertiary Institutions representative	Dr Stephen Hinckley
Mr N Tsurikov	Expert in Mining Radiation Hazards	Dr L Toussaint
Mr F Harris	Expert in Mining Radiation Hazards	
Mr B Cobb	Co-opted member	not applicable

[1] Appointed by the Governor on 19 May 2008 for the period ending 2 August 2009.
[2] Appointed by the Governor on 19 May 2008 for the period ending 4 July 2009.

2009 MEETING ATTENDANCE

	19 Feb	9 Apr	11 Jun	3 SEP	8 Oct	10 Dec
Dr P Psaila-Savona	✓	✓	✓	-	-	-
Dr A Robertson	NA	NA	NA	✓	✓	✓
Dr R Fox	✓	✓	✓	✓	✓	✓
Dr G Groom	✓	✓	A	✓	✓	A
Mr N Hicks	✓	✓	D	✓	✓	NA
Mr M Ross	✓	✓	✓	✓	✓	A
Prof J McKay	✓	✓	✓	✓	✓	✓
Dr M Bennett	✓	✓	✓	✓	D	✓
Mr B Cobb	✓	✓	A	✓	✓	✓
Mr N Tsurikov	✓	✓	✓	A	✓	NA
Mr F Harris	NA	NA	NA	NA	NA	NA

✓ attended A apology D deputy NA not appointed at the time

Attachment 2: Legislation Amendments

RADIATION SAFETY ACT

Consequential amendments were made via the following Acts as follows;

Statutes (Repeals and Miscellaneous Amendments) Act 2009.

Acts Amendment (Bankruptcy) Act 2009.

RADIATION SAFETY (GENERAL) REGULATIONS

None

RADIATION SAFETY (TRANSPORT OF RADIOACTIVE SUBSTANCES) REGULATIONS

None

RADIATION SAFETY (QUALIFICATIONS) AMENDMENT REGULATIONS

None

Attachment 3: Compliance Testing

Medical

A *Compliant*
B *Conditionally compliant*
C *Non-compliant*[3]

Category	A	B	C	Total
CT	45	-	6	51
Dental – intraoral	592	-	14	606
Dental – panoramic and/or cephalometric	80	-	2	82
Fluoroscopic – fixed	44	2	20	66
Fluoroscopic – fixed C or U arm	20	-	6	26
Fluoroscopic – mobile	84	-	9	93
Mammography	58	-	3	61
Radiographic – fixed	99	-	38	137
Radiographic – mobile	74	-	4	78
Total	1096	2	102	1200

Industrial – Fixed Gauges

A *Compliant*
B *Non-compliant*[4]

Category	A	B	Total
Density	680	63	743
In-stream analysis	38	5	43
Level	31	3	34
Thickness	-	-	-
Total	749	71	820

[3] Equipment deemed to be non-compliant may continue to be used for a further three months while the problem is being addressed provided that the reason for non-compliance does not significantly increase the radiation dose to the patient. A re-test is then required. Of the 109 re-tests conducted during 2009, 97% resulted in the equipment being granted either a compliance or conditional compliance certificate.
[4] Equipment that has been assessed as non-compliant cannot be used until it has been re-tested and issued with a certificate of compliance. Of the 10 re-tests conducted during 2009, 100% resulted in the equipment being granted a compliance certificate.

Attachment 4: Industrial Radiation Safety Examinations

Current at 31 December 2009

Category	2009	2008	2007	2006	2005
Borehole Logging	41	78	46	23	28
Fixed Gauges	64	141	78	82	57
Gamma Irradiator	3				
Industrial Radiography	88	56	40	35	26
Industrial Radiography (Assistant)	146	92	65	85	64
Portable Gauges	50	73	96	61	61
Portable Gauges (WA Requirements)	14	8	4	2	0
Transport	20	27	28	11	13
Service – Cabinet X-ray	4	10	1	5	2
Service – Industrial Radiography (X-ray)	0	0	1	0	0
Service – X-ray Analysis	0	4	0	0	0
X-ray Analysis – Use	8	4	0	5	9
X-ray Analysis – Use and Restricted Service	50	69	50	43	27
Total	488	562	409	352	287

Attachment 5: List of Australian Radiation Protection and Nuclear Safety Agency publications for 2009

Title
RPS No. 6 National Directory for Radiation Protection, December 2009.
RPS No. 17 Code of Practice and Safety Guide for Radiation Protection in the Veterinary Medicine (2009)
RPS No. 18 Safety Guide for use of Radiation in Schools – Part 1: Ionizing Radiation (2009).
RPS No. 19 Code of Practice for Radiation Protection in the Application of Ionizing Radiation by Chiropractors (2009).

Attachment 6: Registered Irradiating Apparatus, Electronic Products and Radioactive Substances (sealed sources)

Current at 31 December 2009

A *Irradiating apparatus and electronic products*[5]
B *Radioactive substances (sealed sources only)*

Category	A	B
Bone densitometry	42	-
Cabinet x-ray equipment	112	-
Calibration	2	349
CT	87	-
CT/SPECT	6	-
Dental – intraoral	1670	-
Dental – panoramic and/or cephalometric	234	-
Education and research	15	887
Fluoroscopic – fixed[6]	89	-
Fluoroscopic – mobile	99	-
Gauges – density/level	6	2206
Gauges – in stream analysis	-	132
Gauges – logging	8	311
Gauges – neutron moisture/density portable	-	321
Gauges – other	-	46
Irradiator	-	48
Isotope Production	1	-
Laser – entertainment	26	-
Laser – industrial	52	-
Laser – medical	192	-
Laser – other medical	117	-
Laser – research	82	-
Linear accelerator	11	-
Mammography	70	-
Non-destructive testing	86	88
Non-destructive testing – crawler control	-	8
Portable mineral analyser	-	18
Radiographic – fixed	342	-
Radiographic – mobile	399	-
Sealed Sources – other	-	106
Simulator	1	-

[5] This data column specifically excludes x-ray equipment that is no longer operable but for which compliance testing data is held.
[6] Includes equipment used in DSA/Cardiac Cath Lab

Category	A	B
Special purpose x-ray	62	-
Static detection/measurement	-	3
Static elimination	-	6
Storage	-	155
Sun Tanning Unit	69	-
Superficial radiotherapy	4	-
Test source	3	-
Therapy	1	42
Therapy – HDR brachytherapy	-	3
Transilluminator	100	-
X-ray analysis	257	-
Total	4245	4729

Attachment 7: Licences and Registrations

Current at 31 December 2009

Including individual exemptions granted under Section 6 of the Act.

	X-ray and/or Electronic Products		Radioactive Substances		TOTAL	
	2009	2008	2009	2008	2009	2008
Licences	3636	3401	1708	1554	5344	4955
Registrations	1460	1466	334	333	1794	1799
TOTAL	5096	4867	2042	1887	7138	6754
Change from 2008	+ 4.7%		+8.2%		+5.7%	

Attachment 7 (cont)

Purposes for Licences and Exemptions from Licence

Note: A *single licence may be granted for one or more purposes.*

A *Granted or renewed in 2009*
B *Total current*

A	B	Purpose
0	6	Bone Densitometry
1	6	Bone Densitometry (Exemption)
21	56	Cabinet X-ray Equipment
0	1	Cobalt Teletherapy Maintenance
13	46	Compliance Testing - Diagnostic X-ray Equipment
33	87	Compliance Testing - Radioactive Gauges
0	3	Cyclotron Operation
0	6	Cyclotron Servicing
3	5	Education (Apparatus)
10	36	Education (Substances)
66	186	Fluoroscopy - Medical
41	157	Fluoroscopy - Medical (Exemption)
0	2	Fluoroscopy - Medical (Non-Specialist Exemption)
0	1	Fluoroscopy - Research
1	1	Fluoroscopy - Veterinary
0	2	Gamma Irradiator - Use
114	301	Gauges - Industrial
5	13	Gauges - Industrial (Installation)
1	3	Gauges - Level (CO2)
108	336	Gauges - Logging
134	378	Gauges - Moisture and/or Density (Portable)
1	5	Gauges - Other (Apparatus)
7	24	Gauges - Other (Substances)
0	1	Installation of X-ray Equipment
0	5	Installation of X-ray Equipment - Dental
0	0	Installation of X-ray Equipment - Linear Accelerator
1	11	Lasers - Acupuncture
5	7	Lasers - Chiropractic
11	45	Lasers - Dental
3	8	Lasers - Educational
7	15	Lasers - Entertainment
22	59	Lasers - Industrial
84	221	Lasers - Medical
28	63	Lasers - Physiotherapy

A	B	Purpose
10	28	Lasers - Research
16	46	Lasers - Service
0	0	Lasers - Veterinary
0	0	Manufacture of Lasers and Laser Products
1	2	Manufacture of X-ray Equipment
0	2	Medical Physics
1	5	Medical Physics - Radiotherapy (Apparatus)
1	5	Medical Physics - Radiotherapy (Substances)
13	63	Medical Radiation Technology - Diagnostic Nuclear
161	903	Medical Radiation Technology - Medical Imaging
39	157	Medical Radiation Technology - Radiation Therapy Irradiating Apparatus
66	194	Medical Radiology
3	5	Non-Medical Irradiation
14	28	Nuclear Medicine - Diagnostic
14	27	Nuclear Medicine - Therapeutic
0	1	Nuclear Medicine - Veterinary
3	13	Pathology Tests
13	40	Portable Mineral Analysers
36	88	Portable Mineral Analysers (X-ray)
5	8	Possession of X-ray Equipment - Diagnostic Medical
0	1	Quality Assurance Procedures
24	43	Radioactive Ores - Mining and/or Processing
3	6	Radioactive Substances - Calibration Sources
0	3	Radioactive Substances - Medical
14	41	Radioactive Substances - Sale
11	18	Radioactive Substances - Service of Devices
3	4	Radioactive Substances - Tracer Studies
3	18	Radioactive Substances - Tracer Studies (Industry)
5	5	Radiography - Chiropractic (Exemption)
18	38	Radiography - Chiropractic (Extended)
52	132	Radiography - Chiropractic (Restricted)
136	300	Radiography - Industrial (Gamma)
134	298	Radiography - Industrial (X-ray)
1	4	Radiography - Medical (Direction and Supervision)
0	1	Radiography - Security
210	534	Radiography - Veterinary
1	3	Radiology - Veterinary
3	15	Radiopharmaceutical Manufacture and Dispensing
5	14	Radiotherapy - Medical (Apparatus)
8	19	Radiotherapy - Medical (Substances)
4	8	Radiotherapy - Medical Superficial

A	B	Purpose
0	2	Radiotherapy - Veterinary (Apparatus)
1	3	Radiotherapy - Veterinary (Substances)
5	18	Research
14	76	Research - Unsealed Radioactive Substances
1	4	Research - X-ray
9	21	Sale of Electronic Products
28	66	Sale of X-ray Equipment
7	20	Service of X-ray Equipment - Analytical
16	25	Service of X-ray Equipment - Dental
26	76	Service of X-ray Equipment - Diagnostic
4	15	Service of X-ray Equipment - Diagnostic (Extended)
0	0	Service of X-ray Equipment - High Energy Therapeutic
2	6	Service of X-ray Equipment - Industrial NDT
0	2	Service of X-ray Equipment - Intraoral
0	12	Service of X-ray Equipment - Linear Accelerators
9	28	Service of X-ray Equipment - Other
0	1	Smoke Detectors - Sale
0	7	Special Purpose Enclosed X-ray Equipment
0	0	Static Detection
0	1	Static Electricity Measurement
1	2	Static Elimination
6	7	Storage
5	22	Transilluminators
34	90	Transport
0	2	X-ray Analysis
0	1	X-ray Analysis (Research)
18	50	X-ray Analysis - Use
79	179	X-ray Analysis - Use and Service (Restricted)

Attachment 7 (cont)

Purposes for Registrations and Exemptions from Registration

Note: A *single registration may be granted for one or more purposes.*

A *Granted or renewed in 2009*
B *Total current*

A	B	Purpose
6	11	Bone Densitometry
10	23	Bone Densitometry (Exemption)
12	60	Cabinet X-ray Equipment
1	1	Cyclotron Operation
0	1	Disposal of Radioactive Waste – Mt Walton East IWDF
0	4	Education (Apparatus)
3	9	Education (Substances)
2	5	Education - Demonstration Radioactive Sources
1	3	Education - Demonstration Radioactive Sources (Exemption)
0	4	Education - Demonstration Sources
0	1	Fluoroscopy - Medical
0	0	Fluoroscopy - Medical (Image Intensifiers)
1	1	Fluoroscopy - Veterinary
0	2	Gamma Irradiator
40	112	Gauges - Industrial
2	4	Gauges - Level (CO2)
8	22	Gauges - Logging
14	34	Gauges - Moisture and/or Density (Portable)
3	6	Gauges - Other (Apparatus)
2	5	Gauges - Other (Substances)
5	11	Lasers - Acupuncture
2	4	Lasers - Chiropractic
16	37	Lasers - Dental
0	1	Lasers - Educational
4	14	Lasers - Entertainment
13	24	Lasers - Industrial
0	2	Lasers - Manufacture
29	78	Lasers - Medical
13	36	Lasers - Physiotherapy
2	5	Lasers - Research
3	6	Lasers - Sale, Service, Maintenance and Testing
1	3	Lasers - Storage
0	0	Lasers - Veterinary

A	B	Purpose
1	2	Manufacture of X-ray Equipment
32	99	Medical Radiology
1	2	Non-Medical Irradiation
8	22	Nuclear Medicine
2	5	Nuclear Medicine – CT (X-ray)/SPECT
0	1	Nuclear Medicine - Veterinary
3	10	Pathology Tests
5	15	Portable Mineral Analysers
21	58	Portable Mineral Analysers (X-ray)
17	42	Radioactive Ores - Mining and/or Processing
1	5	Radioactive Substances - Calibration Sources
2	2	Radioactive Substances - Medical
0	7	Radioactive Substances - Sale
0	2	Radioactive Substances - Service of Devices
0	0	Radioactive Substances - Tracer Studies
1	2	Radioactive Substances - Tracer Studies (Industry)
0	0	Radiography - Chest Screening
18	53	Radiography - Chiropractic
2	7	Radiography - Chiropractic (Referrals)
232	287	Radiography - Dental
0	1	Radiography - Forensic
6	21	Radiography - Industrial (Gamma)
2	17	Radiography - Industrial (X-ray)
3	10	Radiography - Mammography Screening
0	2	Radiography - Medical (GP Extended)
12	58	Radiography - Medical (Operator)
3	15	Radiography - Medical (Unrestricted)
19	64	Radiography - Medical Ancillary (Referrals)
3	7	Radiography - Physiotherapy Referrals
2	5	Radiography - Podiatry Referrals
0	1	Radiography - Security
81	199	Radiography - Veterinary
0	1	Radiography - Veterinary (Hospitals)
1	2	Radiology - Veterinary
1	2	Radiopharmaceutical Manufacture and Dispensing
1	3	Radiotherapy - Medical (Apparatus)
5	11	Radiotherapy - Medical (Substances)
1	1	Radiotherapy - Veterinary (Apparatus)
1	1	Radiotherapy - Veterinary (Substances)
0	2	Regulatory Authority
0	7	Research (Substances)
8	14	Research - Unsealed Radioactive Substances

A	B	Purpose
2	5	Research - X-ray
2	4	Sale of Electronic Products
8	24	Sale of X-ray Equipment
1	2	Secondary Schools - Demonstration Sources
14	29	Secondary Schools - Demonstration Sources (Exemption)
5	14	Service of X-ray Equipment
0	2	Smoke Detectors - Sale
24	45	Solaria - Possession and Operation
3	5	Special Purpose Enclosed X-ray Equipment
0	1	Static Electricity Measurement
0	3	Static Elimination
5	14	Storage (Apparatus)
11	14	Storage (Substances)
4	14	Transilluminators
2	11	Transport
2	7	X-ray Analysis
29	84	X-ray Analysis - Use

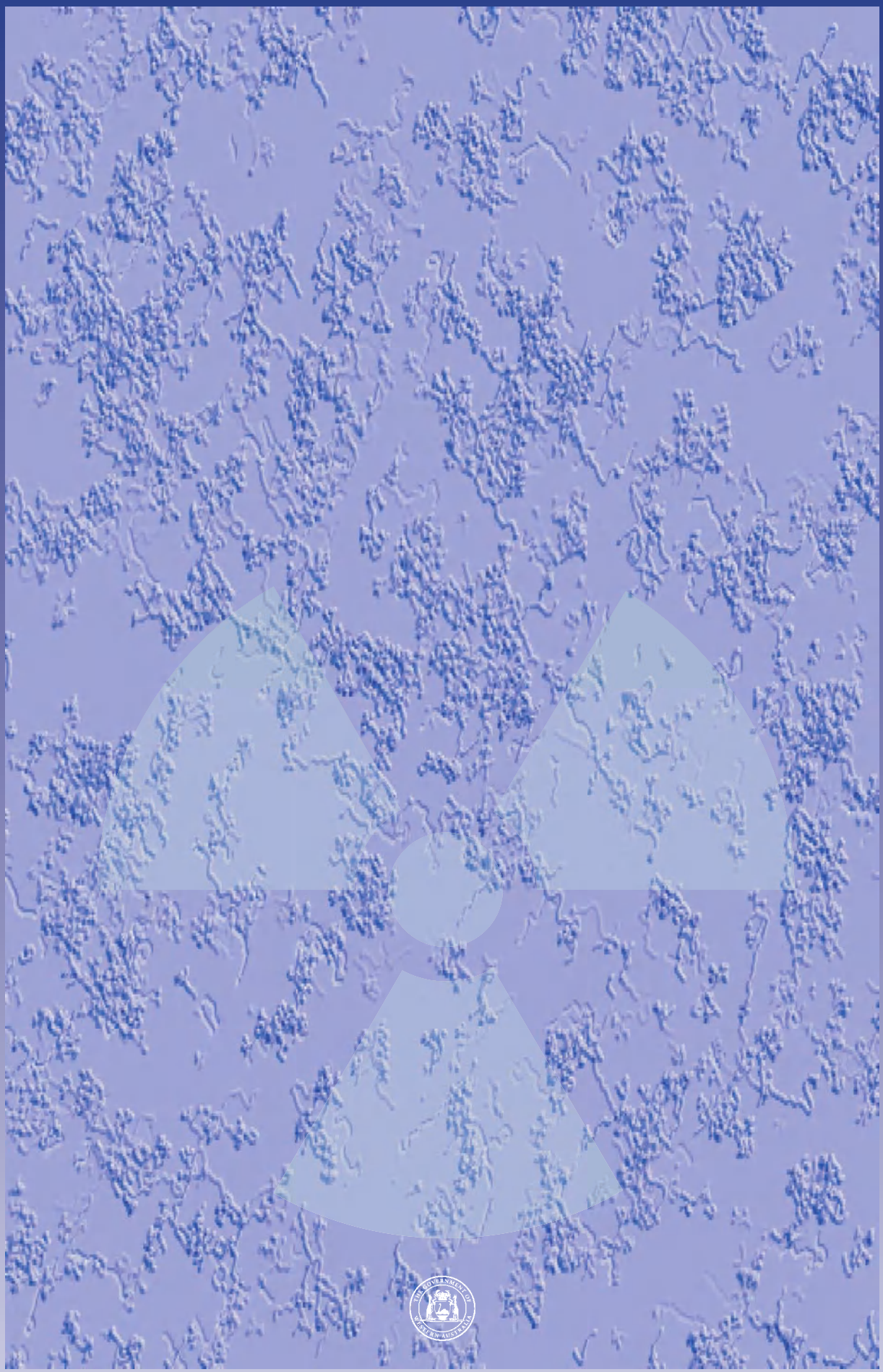
ABBREVIATIONS

General Terminology

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CT	Computed Tomography
CT/SPECT	Computed Tomography/Single-Photon Emission Computed Tomography
DSA	Digital Subtraction Angiography
HDR	High Dose Rate
NDT	Non-Destructive Testing
NHMRC	National Health and Medical Research Council
PET	Positron Emission Tomography
TLD	Thermo-Luminescent Dosimeter

Units of Activity

Bq	becquerel (1 disintegration per second)
MBq	megabecquerel (1,000,000 becquerels)
GBq	gigabecquerel (1,000,000,000 becquerels)

Units of Effective Dose

Sv	sievert
	(1 joule per kilogram multiplied by a modifying factor for the type of radiation and the radiological sensitivities of the organs and tissues being irradiated)
mSv	millisievert (one thousandth of a sievert)
µSv	microsievert (one millionth of a sievert)