Australian Nuclear Science & Technology Organisation
ANNUAL REPORT 1996-1997

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CONTACT DETAILS

ANSTO
Lucas Heights Science and Technology Centre
New Illawarra Road, Lucas Heights,
New South Wales 2234

Postal Address:
ANSTO
Private Mail Bag 1
Menai, NSW 2234

Telephone:  (02) 9717 3111
Facsimile:   (02) 9543 5097
Telegrams:  ANSTO, Sydney
Email:      communications@ansto.gov.au
Internet
Home Page: http://www.ansto.gov.au

Guided tours of the ANSTO site and laboratories are available for individuals, groups and schools at no cost.

Bookings and Information:
Telephone:  (02) 9717 3168

Edited by Jeane Balcombe, ANSTO
Design by Laura Edwards, ANSTO
Photography by Tim Tapsell,
Paul De Sensi and ANSTO staff
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The Hon. Peter McGauran MP
Minister for Science and Technology
Parliament House
Canberra
ACT 2600

My dear Minister

In accordance with Section 63M(1) of the Audit Act 1901, I am pleased to present the Annual Report of the Australian Nuclear Science and Technology Organisation for the period 1 July 1996 to 30 June 1997.

Audited Group financial statements for the year ended 30 June 1997 are disclosed in the Report. Also included in accordance with Section 63M(2) of the Audit Act 1901 is a Report by the Auditor General.

Yours sincerely

S M Richards
Chairman
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ANSTO's Mission

ANSTO's Mission consists of four components:

to provide expert scientific and technical advice across the nuclear fuel cycle to government and to support Australia's national strategic and nuclear policy objectives;

to operate large nuclear science and technology based facilities in Australia and overseas for the benefit of industry and the Australian research and development community, including postgraduate students and staff in higher education;

to undertake research on specific topics to advance the understanding of nuclear science and the nuclear fuel cycle; and

to apply resulting technologies and other relevant, unique capabilities to focused research and development and other scientific activities to increase the competitiveness of Australian industry and improve the quality of life for all Australians.

Enabling Legislation

The Australian Nuclear Science and Technology Organisation (ANSTO) is a body corporate established by the Australian Nuclear Science and Technology Organisation Ad 1987. The functions and general powers of ANSTO are set out in Part 2, Sections 5 and 6 of the Act. See also 'Functions of the Organisation under the ANSTO Act', Appendix 4 of this Report.

Statement of Compliance

This report is written according to the reporting guidelines provided for statutory authorities in Requirements for Departmental Annual Reports, published by the Department of the Prime Minister and Cabinet in 1994 and updated in February 1996. An index of compliance in provided in Appendix 5.
MEMBERS OF THE BOARD

Ralph Ward-Ambler

Dr Max Richards
Deputy Chairman, 5 July 1996 - 31 December 1996
Chairman from 1 January 1997

Mike Codd
Deputy Chairman from 1 January 1997
Company Director, appointed on 5 July 1996 until 30 June 1999.

Professor Helen Garnett
Executive Director, Member of the Board by virtue of Section 9(1) of the ANSTO Act.

Beryl Ashe

Dr Tony Gregson
Primary producer, Company Director, reappointed on 5 July 1996 until 31 December 1998.

Associate Professor Fred Khafagi

Greg Taylor
Secretary, Department of Industry, Science and Tourism, appointed on 5 July 1996, resigned on 31 January 1997.
This is my first report as Chairman of ANSTO and the 45th Annual Report of ANSTO or its predecessor, the Australian Atomic Energy Commission.

Net Parliamentary appropriation for ANSTO for 1996-97 was $59.79 million, 8.8% less than in 1995-96. Operating revenue from independent sources totalled $27.25 million, slightly less than in 1995-96. Expenditure to maintain and upgrade capital stock was $14.48 million.

ANSTO is responsible for operating, maintaining and keeping safe a number of major nuclear facilities on a National Facilities basis. They include the research reactor HIFAR, the National Medical Cyclotron (NMC) and the Australian National Tandem Accelerator for Applied Research (ANTARES). The quality and performance of these facilities defines ANSTO's ability to meet its obligations.

The 1995-96 Chairman's report explained the issues surrounding HIFAR, not least the urgent need for a decision regarding the reactor's refurbishment or replacement if a hiatus in the provision of nuclear services and products was to be avoided. All options were presented to Government during the year and the decision to replace HIFAR at Lucas Heights, subject to environmental approvals, has just been made as this Report goes to press. Meanwhile, the facility has continued to operate satisfactorily within its limitations. HIFAR's quality management system was certified by an independent accreditation body as complying with the NZS/AS-ISO 9001 international standard.

During the year, major upgrades were made to the NMC production facilities. ANSTO staff designed, built and installed two new beam lines for the irradiation of Single Photon Emission Computed Tomography and Positron Emission Tomography targets. The NMC already complies with the quality assurance guidelines of the Therapeutic Goods Administration and the Codes of Good Manufacturing Practice; it continued to develop quality systems for accreditation under the Australian/New Zealand ISO 9000 Series.

Several major elements of ANTARES were upgraded during the year to improve both the energy stability and the focal properties of the particle beam. The combined number of operational days provided for ion beam analysis to university researchers (for both the 3MV Van de Graaff accelerator and ANTARES) was 200, up 25% over the previous year.

The body of the Annual Report documents the uses to which these facilities have been put by universities, industry, medicine and Government. In particular $12.34 million revenue was generated from the sale of radiopharmaceuticals, a growing business for ANSTO and Australia that is dependent on the replacement of HIFAR.

Expertise and credibility in nuclear safety is one of the major benefits to Australia of the experience accumulated by ANSTO staff in operating these National Facilities. ANSTO is Australia's sole repository of this knowledge and expertise, and the
uses to which it is put are many. During the year it resulted in:

• involvement by some 60 ANSTO staff in IAEA expert missions or training courses in the region

• a successful workshop on nuclear safety culture, which was hosted by ANSTO in Sydney under the auspices of the International Conference for Nuclear Cooperation in Asia

• utilisation by Government of ANSTO’s specialist resources in health physics to provide radiation monitoring assistance and an emergency response capability for visits of nuclear powered warships to seven Australian ports

• Important contributions by ANSTO’s scientists to an international study of the radiological situation on Mururoa and Fangataufa atolls, which was initiated following cessation of French nuclear testing in the South Pacific

• recognition of ANSTO’s expertise in radioactive waste immobilisation as demonstrated by the US Department of Energy decision to shortlist synroc as an option for the immobilisation of excess weapons grade plutonium. The formal decision on the selected waste form is expected in the second half of 1997.

Following the thorough Mission Review of the organisation that was completed in December 1994, ANSTO has made considerable progress in restructuring its policies and practices in support of industry, academia and government. Further steps taken during 1996-97, consistent with review recommendations, included:

• the development and presentation of a Strategic Plan for the period 1996-1997 to 1999-2000

• the establishment of a Technical Advisory Committee (TAC) of the Board. The Board now has advice, independent of management, covering three important areas: safety, through the Safety Review Committee and the Nuclear Safety Bureau; financial and compliance matters, through the Board Audit Committee; and research, through the TAC.

During the year the Minister, the Hon. Peter McGauran, announced a number of changes to the ANSTO Board. Ralph Ward-Ambler completed a highly productive term as Chairman at the end of 1996. Beryl Ashe completed her term on 30 June 1997 and her excellent contribution to the Board’s business is acknowledged. Professor Fred Khafagi, who has a strong nuclear medicine background, was appointed to the Board for a 3-year term from May 1997.

The Board records its appreciation of the leadership shown by the Executive Director, Professor Helen Garnett, and the continued dedication and effort of all staff.

Dr Max Richards
Chairman
During 1996-97 ANSTO released a new Strategic Plan for the period till June 2000. This plan, which arose from a lengthy process of consultation as reported last year, builds on the successes and lessons learnt from dealing with industry and other customers in recent years.

The Strategic Plan clearly identifies ANSTO’s vision as being ‘for nuclear science and technology to be accepted as benefiting all Australians and for ANSTO to be acknowledged as the premier nuclear science and technology organisation within the Asia Pacific Region’. To strive toward this vision requires ANSTO to develop new knowledge in areas where nuclear science and technology has the potential for generating future socio-economic benefits, as well as using existing knowledge and know-how to deliver quality services and products to our customers and to enable effective management of a wide range of industrial, environmental and medical problems.

In accordance with the Strategic Plan, ANSTO has continued to focus its activities in six core business areas.

**Knowledge development and strategic research**

To underpin the development of the core science business areas, fulfil its mission and strategically position itself for the future, ANSTO has directed the majority of its strategic research at seven topics, which were launched during the year. The topics are:

- **International cooperative research to enhance safety of nuclear facilities and safeguards for nuclear materials**
  - developing ways of verifying the non-proliferation of nuclear materials and characterising and monitoring the level of safety of nuclear activities. This includes work to enhance the region's capability to predict the consequences of releases of nuclear material into the atmosphere.

- **Environmental dynamics - application of nuclear techniques**
  - applying nuclear techniques to develop and validate models to predict the fate and behaviour of terrestrial material in the marine environment.

- **Global climate change - application of nuclear techniques**
  - applying nuclear techniques to assess and understand global climate changes over the past 500 000 years and possible changes over the next 100 years.

- **Radioactive waste management**
  - developing advanced technologies for handling low, intermediate and high level wastes, and developing knowledge to underpin radioactive waste disposal strategies.

- **Ecological sustainability of the mining and mineral industries**
  - developing new processes to separate uranium and other radionuclides from solution for
applications in the milling of uranium ores and the treatment of radioactive waste streams.

- developing technologies to reduce pollutant release from mine sites and minimise their impact on the environment.

Radionuclides and radiopharmaceuticals for the 21st Century

- developing processes and products that use radionuclides to enhance the effectiveness of the health, petrochemical and power industries. The focus is on developing radioparticulates for pre-clinical evaluation of liver metastases and synovectomy, optimising specific industrial processes; and developing new radiopharmaceuticals for use in neurology and oncology.

Design and process of novel interfaces

- developing technologies based on nuclear analytical procedures; manipulating structures and interfaces to design and process novel materials for use in functional devices.

Technical Advisory Committee

During the year, the first meeting of the Technical Advisory Committee (TAC) was held to review the organisation's program of strategic research. The Committee consists of four people, two from Australia and two from overseas, who are recognised as science and technology leaders within the academic, industrial and scientific communities. The TAC was established by the Board to advise it on:

• whether the topics being researched are relevant, given the mission and core science businesses of ANSTO

• whether the projects being undertaken are nationally or internationally important and are realistic, given the resources of ANSTO, and

• whether the results of the research work are of world standing, timely, relevant and cost effective.

Knowledge application

Achieving our vision also requires us to apply our knowledge and know-how to applied research and development, to our work with industry and Government agencies and to our provision of products and services. Over the past year some of the highlights of this work, additional to those mentioned in the Chairman's report, were:

International strategic relevance of nuclear science and technology

• Continued involvement in the IAEA Regional Cooperation Agreement (RCA) for research, development and training related to nuclear science and technology. Overall, 28 IAEA fellows were trained in Australia during the year.

• Application of ultra-sensitive measurement of environmental samples using accelerator mass spectrometry (AMS) in support of the IAEA's nuclear safeguards program.

Core nuclear facilities operation and development

• Certification of HIFAR quality management systems as complying with the NZ/AS-ISO 9001 International Standard for quality management.

• Operation of the HIFAR research reactor for 7250 hours at an average power of 10.04 MW. Excluding 13 scheduled shutdowns for fuel changes, HIFAR was available for 94% of the scheduled operating time.

• Irradiation of more than 8000 targets for research and to produce medical and industrial radioisotopes. Over 20,000 mineral samples were also irradiated for commercial analysis. Income of close to $2 million was gained from irradiating 820 batches of silicon for overseas electronics companies.

• Upgrades to the National Medical Cyclotron (NMC) production facilities. Two new beamlines were installed for irradiating targets used to produce Single Photon Emission Computed Tomography and Positron Emission Tomography radiopharmaceuticals.

• Provision of ultra-sensitive analysis by the ANTARES AMS facility of the long-lived radioisotopes, carbon-14, beryllium-10, aluminium-26, chlorine-36 and iodine-129 for Australian and international researchers. More than a thousand radiocarbon samples were analysed. Highlights included dating Aboriginal rock art from the Kimberley region of Western Australia and the 'Iron Crown' of Charlemagne, the first Holy Roman Emperor.
Application of nuclear science and technology to the understanding of natural processes

- Completion of a project to study atmospheric fine particles and gases in the Jakarta region. The results will be used to guide Indonesian authorities in assessing the effectiveness of pollution control programs.
- Development and trial of methods to predict outbursts of gas and coal dust in underground coal mines using radon detectors.

Treatment and management of man-made and naturally occurring radioactive substances

- Successful operation of a pilot plant to demonstrate the process flowsheet for the Kintyre uranium project in Western Australia.
- Development of the synroc concept for immobilising high-level radioactive waste, including the collaborative program with the Japan Atomic Energy Research Institute, continued on schedule. Results of joint research provided independent confirmation of synroc as an advanced second generation waste-form.
- Continuation of studies with the French Atomic Energy Commission on waste-form durability and the application of cold-crucible technology to processing synroc, including its use for the solidification of high level radioactive waste sludges at Hanford in the United States.
- Signing of contracts with the Lawrence Livermore National Laboratory in the United States to demonstrate synroc for the immobilisation of weapons-grade plutonium.
- Irradiation of up to 15 million pupae of Queensland fruit fly each week for NSW Agriculture in ANSTO’s gamma irradiation facility (GATRI).
- Increased sales of radiopharmaceuticals and radioisotopes for medical, industrial and research use. Export sales to markets in New Zealand, Taiwan, the Philippines, Korea and China increased.
- Production of photovoltaic film coated window modules to a size of 10 cm by 10 cm. Potential applications include installation on high rise buildings where the windows could supplement the electricity supply.
- Assessment of pressure equipment operating under cyclic conditions for Pacific Power using ANSTO’s non-destructive testing expertise.
- Confirmation by the National Association of Testing Authorities (NATA), Australia, of ANSTO’s accreditation as a mechanical testing laboratory.
- Provision of 39 radiation protection courses to 346 personnel from 115 organisations in industry and government.
- Provision of occupational health and safety courses on working in confined spaces, safety in laboratories and occupational hygiene throughout Australia.
- Assessment of reliability and maintainability in support of designs for light-rail passenger vehicles for the Kowloon-Canton Rail Corporation.

Competitiveness and ecological sustainability of industry

- Completion of a collaborative project to develop remedial technologies for the detoxification of polluted harbour sediments. Removal of contaminant metals to regulatory levels was achieved for all sediment types tested.
- Successful demonstration of a new solvent extraction process for recovering nickel and cobalt from solution at the pilot plant scale.
- Demonstration in Montana in the United States of a process for oxidising and immobilising arsenic in waste streams from industrial and mining activities. The resulting solid waste satisfied the standard US leach test for landfill disposal.
- Completion of a study for the Office of the Supervising Scientist on the extent of acid mine drainage in Australia.
- Development with an international team of experts of an overburden management plan for the Grasberg copper/gold mine in Irian Jaya, Indonesia.

Organisational development and support

- ANSTO is continuing to strive to develop its staff and improve the effectiveness and efficiency of its procedures. Over the past year senior...
management have participated in management development programs and a cross-section of staff have benefited from teaming and communication programs. A new enterprise agreement lasting till February 2000 was also concluded, providing benefits for both the staff and the organisation.

Other achievements were:

• Savings in warehouse operations achieved through increased reliance on just-in-time purchasing principles.

• Introduction of staff courses tailored to the organisation’s strategic goals in project management, teamwork, leadership and setting objectives.

• Further implementation of internal quality system audits to identify areas for process, product and safety improvement.

• Installation of a Silicon Graphics multi-processor machine to replace the Fujitsu vector computer.

• Upgrade of the site computer connection to the Australian Academic Research Network (AARNet), resulting in faster and more reliable services.

• Implementation of a voice mail system that will support 500 users.

**Major research facilities development**

**Synchrotron**

The Australian Synchrotron Research Program, a funded major national facility, was founded on 1 July 1996. ANSTO is the managing agent for this program, which is a partnership between ANSTO, CSIRO, the University of Sydney, Monash University, the University of Melbourne, the University of New South Wales, the University of Queensland, the Australian National University and, as an associate, the University of Canberra.

Through this program, access to X-ray beams is provided at state-of-the-art synchrotron facilities in the United States and Japan for research scientists and graduate students.

**Reactor**

A significant amount of effort over the past year has been directed at providing data and information to facilitate Government consideration of the need for an ongoing reactor facility in Australia, the management of spent fuel and regulatory arrangements for nuclear and radiation facilities. As this report goes to press, we at ANSTO have been delighted by the Government’s decision to replace HIFAR with a modern research reactor, to invoke a strategy for spent fuel management and to form a new regulatory authority, the Australian Radiation Protection and Nuclear Safety Agency (ARPNSA) to regulate nuclear facilities and radiation practices in Commonwealth establishments.

**The future**

ANSTO’s efforts over the forthcoming year will be directed at completing the required assessments under the *Environment Protection (Impact of Proposals) Act 1974* for the replacement reactor facility and spent fuel management, and at developing, in consultation with the scientific community across Australia, the detailed specifications needed for the replacement reactor tender documentation.

The Government’s decision to replace the reactor will enable ANSTO to focus on its mission, secure in the knowledge that it is supported by Government. With renewed vigour and determination, all at ANSTO will work to ensure Australia benefits from the peaceful uses of nuclear technology, expertise and understanding in fields as diverse as environmental management, industrial development, medicine, new materials and education.

Professor Helen Garnett
Executive Director
CORE BUSINESS AREAS

INTERNATIONAL STRATEGIC RELEVANCE OF NUCLEAR SCIENCE AND TECHNOLOGY

ANSTO provides a radiation monitoring service during visits of nuclear-powered warships to Australian ports. Seven visits were monitored during the year.

Inset: Dr Keith Ketheeswaran (left), Managing Director of Quality Assurance Services, Australia, presenting an AS/NZS ISO 9001 certificate to ANSTO's Executive Director, Prof. Helen Garnett and Quality Accreditation Project Manager, Mr Bob Mc Aneny.

Driver: Government

OBJECTIVES:

(a) To provide government with quality scientific and technical advice on the nuclear fuel cycle, including reactor operations, reactor safety and safeguarding of nuclear materials.

(b) To make significant contributions to national and international research and development in selected fields associated with the nuclear fuel cycle, particularly reactor and radiation safety and safeguards, and be recognised as a leader in the application of knowledge in these fields. These activities will be commensurate with the Government's nuclear non-proliferation and other nuclear-related interests.
OUTCOMES

- As a result of receiving prompt technical advice on nuclear issues, ANSTO stakeholders in the national interest area, notably Government departments, were able to make informed assessments and undertake policy initiatives, particularly in the areas of nuclear safety, radioactive waste management and liability for nuclear damage.

- Significant contributions were made to both the International Atomic Energy Agency (IAEA) and the Organisation for Economic Cooperation and Development's (OECD) Nuclear Energy Agency (NEA) programs. A total of 60 ANSTO staff were involved with IAEA expert missions or training courses in the Region. Visits by 28 IAEA Fellows to ANSTO and other Australian institutions were coordinated. As well, ANSTO experts participated, by invitation, in seminars, coordinated research programs, workshops and expert meetings of relevance to Australia.

- ANSTO maintained a prominent role in the IAEA Regional Cooperative Agreement (RCA) between 17 regional Member States as recognised by its leadership of projects in radiation protection infrastructure, nuclear medicine and industrial applications of radioisotopes and radiation technology. The Director, Government and Public Affairs, is the Australian RCA National Coordinator and was invited to take the lead in developing policy positions on future RCA management arrangements. Significant contributions were made towards enhanced radiation protection in the region. The Phase 3 RCA program in radiation protection for 1998-2002 was developed by a task group from the region, chaired by ANSTO's Director, Safety, who was elected as chairperson of the coordination group for implementing the program. ANSTO's expertise in radioisotope and radiation technology resulted in the organisation playing a prominent role in RCA projects on radiation sterilisation and the use of isotopes in industrial, medical and environmental applications.

- ANSTO continued to reinforce the network of bilateral and multilateral links with its counterpart organisations in the Asia/Pacific region, thereby facilitating greater understanding of nuclear safety, radioactive waste management, research reactor utilisation and other areas, and their impact within the region.

- ANSTO continued to coordinate Australia's participation in the IAEA's International Nuclear Information System (INIS). During the year ANSTO worked with the INIS Secretariat of the IAEA to develop more cost effective methods of creating the database, thus improving the efficiency of INIS-based services for the benefit of Australian users. The database is now available through ANSTO at a fraction of its previous cost. By participating in the Nuclear Information System project, ANSTO also supported regional efforts to establish intra- and cross-country computer network links. These links will enable users in the RCA Member States to contact individuals and institutions and access computer-based resources for research collaboration, information exchange, technology transfer, resource-sharing and communication.

- ANSTO's specialist resources in health physics were utilised by the Commonwealth Government and the State Governments to provide radiation monitoring assistance and an emergency response capability for visits of nuclear-powered warships to seven Australian ports. ANSTO staff participated in port validation exercises in Darwin, Brisbane, Melbourne, Hobart, Port Kembla and Gladstone. Technical experts were provided for four meetings of the Visiting Ships Panel (Nuclear) during the year.

- Regular inspections demonstrated that ANSTO had met its national and international safeguards
commitments associated with nuclear materials held on the site. ANSTO continued to support the IAEA's nuclear safeguards monitoring program by analysing environmental samples using its ultra-sensitive Accelerator Mass Spectrometry facility.

- ANSTO scientists made important contributions to an international study of the radiological situation on Mururoa and Fangataufa atolls, which was initiated following cessation of French nuclear testing in the South Pacific. Staff participated in the IAEA sampling program at the atolls, analysed selected samples using accelerator mass spectrometry and were involved in assessing the impact of the underground tests.

- Expert advice provided by ANSTO engineers enabled the Bangladesh Atomic Energy Authority to solve a technical problem with its 3MW TRIGA research reactor.

ACTIVITIES AND OUTPUTS

Services to support customers and stakeholders

ANSTO is Australia's national nuclear research organisation and so has a key role in making available its specialised scientific and technical expertise to its stakeholders, particularly in government. During the year, extensive information on topical nuclear issues was provided to government bodies, organisations, the media and members of the public. Power reactor and fuel cycle programs in Asian countries, where the most rapid nuclear power developments are taking place, continued to attract interest, as did safety and radioactive waste issues.

A review of developments in overseas nuclear power and nuclear fuel cycle programs was issued every quarter. Briefings were prepared on specific subjects of interest and for Australia's bilateral nuclear consultations with France, Japan and the Republic of Korea. Incidents at facilities operated by Japan's government-owned nuclear fuel cycle company led to the suspension of operations at two prototype power reactors and the Tokai reprocessing plant. The investigations into the causes of these incidents, as well as the impact on the public acceptance of nuclear power in Japan, are being closely monitored.

ANSTO prepared detailed technical advice for the Government on issues relating to the future of the HIFAR research reactor, ongoing strategies for the management of the research reactor spent fuel, and the establishment of a national regulatory body for Commonwealth activities involving the use of radioactive materials and radiation. ANSTO continued to locate a liaison officer within the Canberra offices of the Department of Industry, Science and Tourism to assist with the organisation's contacts with Departments.

A submission was made, and evidence presented, to the Senate Select Committee on Uranium Mining and Milling. The submission outlined ANSTO's expertise and its application in optimising uranium milling operations and assessing and remediating the environmental impacts of mining, and also its perspective on international nuclear developments. A submission was also made to the Department of Primary Industries and Energy in response to its Green Paper on Sustainable Energy Policy for Australia. This highlighted the major positive role already played by nuclear power in Australia's energy and greenhouse gas balances through its uranium exports for electricity production.

Funds from the Government's Nuclear Expertise Steering Group established to sustain Australia's nuclear technology capability were used by ANSTO to provide the IAEA with the services of a safety expert. He participated in expert missions, including some to former Eastern bloc countries, and contributed to the development of an incident reporting system for research reactors. The experience gained has significantly assisted ANSTO's research into safety culture. The same source of funding allowed an ANSTO chemical engineer to be attached to British Nuclear Fuels Ltd, Sellafield, for six months to gain experience in operating and modelling complex solvent extraction processes.

ANSTO presented a paper at the Nuclear Issues Seminar in Fiji, which was organised by the South Pacific Forum Secretariat in March. One of the objectives of the seminar was to provide information to South Pacific countries on the process, which commenced in April, for the review of the Nuclear Non-Proliferation Treaty in the year 2000.
**National science initiatives**

The Executive Director continued to be a member of the Coordination Committee on Science and Technology and the International Science and Technology Advisory Committee.

ANSTO made submissions to the Mortimer Review of Business Programs for Investment, Innovation and Export, and the Stocker Review of Arrangements for Publicly Funded Science and Technology in Australia.

**Overseas representation**

As a key part of its international linkages, ANSTO maintains specialised representation through three Counsellor (Nuclear) posts located in the Australian diplomatic missions in Vienna, London and Washington DC. These posts facilitate technical contacts with the IAEA and OECD/NEA and provide essential linkages between ANSTO and those geographical regions most active in nuclear science and technology. Dr Maurice Ripley replaced Mr Peter Duerden as Counsellor (Nuclear) in Vienna in September.

**International cooperative research to enhance safety of nuclear facilities and safeguards for nuclear materials**

Three major strategic research and development projects were initiated to advance Australia’s contribution in this area.

The first project, ‘Environmental Indicators of Nuclear Activity’, seeks to develop a methodology for remotely establishing the type of nuclear activity being conducted at nuclear installations and is therefore closely linked with other initiatives on the safeguarding of nuclear materials. The work will extend ANSTO’s capabilities in the accelerator mass spectrometry area and relies on an actinide beamline currently under construction.

The second project, ‘Safety Culture’, will establish methods for assessing and improving safety culture at nuclear installations. A safety culture workshop conducted in Sydney in early 1997 served to contrast and compare the various approaches to nuclear safety culture in the region. It also served to raise ANSTO’s profile in the region and to underline its safety history. A follow-up workshop on research reactor safety culture is planned for early 1998.

A third project, ‘Radiological Consequence Model’, is focused on developing a capability to model and predict the consequence of a postulated, regional, nuclear incident. The model is specifically designed for the tropical and subtropical regions of South-East Asia and will address the shortcomings in radiological information within this region. The project relies on collaboration with the Australian Bureau of Meteorology.

**International Atomic Energy Agency involvement**

The International Atomic Energy Agency is the key international agency responsible for developing recommended international standards in the fields of nuclear safety and radioactive waste management, for administering a system of international safeguards designed to measure national compliance with non-proliferation commitments, and for making available the benefits of nuclear science and technology to IAEA Member States. ANSTO provides the principal technical base for Australia’s relationship with the IAEA.

ANSTO officers participated in a wide range of IAEA expert and consultant meetings on management of research reactor spent fuel, radiation protection, radioactive waste management, the implementation of the International Convention on Nuclear Safety and the development of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. ANSTO’s Director, Materials, was appointed to chair the Agency’s Radioactive Waste Technology Advisory Committee (WATAQ) and its Director, Government and Public Affairs, is a member of the Agency’s Standing Advisory Group on Technical Assistance and Cooperation (SAGTAC).

ANSTO officers provided extensive assistance to the IAEA study of the radiological situation at the French nuclear testing sites at the Mururoa and Fangataufa atolls. These South Pacific atolls were sites for atmospheric and underground nuclear weapons tests by France from 1966 to 1996. The study is being conducted under the guidance and direction of an International Advisory Committee of independent scientific experts, including scientists
from Australia, New Zealand and the South Pacific. ANSTO’s Executive Director is a member of the International Advisory Committee for the study and a senior ANSTO scientist chairs the Task Group dealing with the long-term environmental assessment of the atolls.

In July, a marine scientist from ANSTO was a member of the IAEA team which took environmental samples from the Mururoa and Fangataufa atolls and nearby environs. ANSTO staff used accelerator mass spectrometry to analyse the long-lived fission product, iodine-129, in water and biological samples. ANSTO is one of only a handful of laboratories in the world that can carry out these sensitive measurements. Scientific assessments based on the results of the sampling program and modelling of radionuclide migration are well advanced. The international study is due to report its findings in 1998.

ANSTO officers participated in a number of IAEA Coordinated Research Programs (CRPs). ANSTO hosted the second Research Coordination Meeting of the CRP on the application of non-destructive testing and in-service inspection of research reactors. The meeting was held in Sydney and attended by participants from the IAEA, Austria, Australia, the Czech Republic, the Netherlands, and the United Kingdom. The aim of the CRP is to prepare guidance documentation for the in-service inspection of research reactors.

ANSTO continued to participate in the CRP on applied research on air pollution using nuclear-related analytical techniques. The main objectives of this program are to support the use of nuclear and nuclear-related analytical techniques for research and monitoring studies on air pollution; to identify major sources of air pollution affecting participating countries with particular reference to toxic heavy metals; and to obtain comparative data on pollution levels in urban and rural areas for a wide range of countries.

The final Australian report to the CRP on radionuclide transfer from air, soil and freshwater to the food chain of man in tropical and sub-tropical environments was submitted. The ANSTO contribution identified the limited extent of data currently available for tropical regions of Australia, Papua New Guinea and the South West Pacific islands. Field sampling identified bioconcentration of radioactive caesium by tropical fruits as a potential concern. Experimental studies showed that default, temperate zone factors for strontium and caesium in freshwater fish may be too conservative when determining radiological dose from tropical species.

ANSTO began participating in the CRP on the treatment of liquid effluents from uranium mines and mills during and after operation. ANSTO’s contribution to this program includes research into improving the efficiency of water treatment processes, including the use of low-pressure membrane processes to remove specific contaminants (radionuclides and heavy metals) from process and treated liquors. An ANSTO scientist attended the first meeting of this topic and presented a summary paper describing current practice in Australia.

ANSTO continued to support the Australian Radiation Laboratory in the CRP on site characterisation techniques used in environmental restoration activities. The main thrust of the Australian contribution is in characterising the nature of the plutonium contamination at the former British nuclear weapons test site at Maralinga, South Australia, and assessing the long-term risks, after site remediation, to Aboriginal people leading a traditional lifestyle.

ANSTO staff participated in a range of IAEA expert and consultant meetings. These included an IAEA expert working group drafting a new safety practice on the provision of operational radiation protection services at research reactor facilities; a specialists’ meeting on the application of the concepts of exclusion, exemption and clearance implication for the management of radioactive materials; and a technical committee preparing guidelines for radioactive material transport.

IAEA Regional Cooperative Agreement activities

ANSTO continued to be involved in the IAEA Regional Cooperative Agreement (RCA) for Research, Development and Training Related to Nuclear Science and Technology, although Australian funding limitations restricted involvement in technical activities. The RCA has evolved to represent the most significant component of
Australia's nuclear cooperation with regional countries. The 25th anniversary of its establishment is being celebrated in 1997.

As the RCA National Coordinator, the Director, Government and Public Affairs, represented Australia at the General Conference Meeting of RCA members in Vienna in September 1996, and at the 18th Annual Working Group Meeting held in Myanmar in March 1997. At these meetings, Australia proposed arrangements for strengthening regional management arrangements for the RCA.

ANSTO continued to play an active role in the major Australian-sponsored project on 'The Applications of Isotopes and Radiation Technology to Regional Development with Special Reference to Industry and Nuclear Medicine'. Through the Australian Agency for International Development (AusAID), Australia has provided financial support totalling $1.5 million to this project, which will be substantially completed at the end of 1997. There are three distinct components in this project, which is responding to major needs in the Region. One component is focused on the training of radiation protection, particularly the achievement of uniform standards across the Region, as well as improving the knowledge and expertise of users of radioactive materials in industry and enhancing the regulatory frameworks within the RCA Member States for the control of radioactive materials. Twenty five modules are being produced for technical personnel in distance learning format.

The second component has an emphasis on furthering the application of nuclear techniques to industrial and environmental problems and underpinning the experience and training achieved in earlier support provided in this field by Australia. National seminars were arranged in 11 RCA Member States to provide national organisations, industry and relevant agencies with information on how nuclear techniques could be applied to specific national problems and priorities.

The third component of assistance has been in the field of nuclear medicine and has concentrated on the training of nuclear medicine technologists, using open and distance learning techniques. The aim has been to provide a program of distance education so that practising technologists in the Region could achieve a higher standard and uniformity of education in nuclear medicine technology. This has enabled a more effective use of existing nuclear medicine technology, promoted further development of techniques in nuclear medicine and enhanced the quality of health care in the Region. Following completion of the project, it is anticipated that the nuclear medicine community within RCA Member States will be able to continue their own training programs.

ANSTO continued to participate in the major RCA project on ‘The Use of Isotopes and Radiation to Strengthen Technology and Support Environmentally Sustainable Development’, which is part funded by the United Nations Development Program. This project was substantially completed by the end of 1996 and an ANSTO officer participated in the Terminal Project Review meetings held in Myanmar and Jakarta. ANSTO staff attended the National Coordinators’ Meeting for the sub-project on nuclear analytical techniques (NAT), which took place in Beijing in September. It was combined with the second research co-ordination meeting for the regional Coordinated Research Program on applied research on air pollution in the Asia-Pacific Region using nuclear-related analytical techniques. ANSTO officers attended an RCA Expert Advisory Group meeting in Hyderabad, India, on the application of chemometric and advanced statistical techniques in the evaluation of data produced by the NAT sub-project and similar environmental monitoring and research programs. The meeting overlapped with an IAEA Symposium, also in Hyderabad, on ‘Harmonisation of Health-related Environmental Measurements Using Nuclear and Isotopic Techniques’.

ANSTO’s Director, Safety, is the RCA National Coordinator in Radiation Protection. In February he chaired the Project Formulation Meeting for Phase 3 of the RCA program in radiation protection for 1998-2002, which was held in Korea.

An RCA Regional workshop on distance learning in radiation protection was held at ANSTO in March and attended by participants from 13 Member States. The workshop allowed the participants to review the draft distance learning materials, and to assist in formulating trials of the materials, which are to be conducted in the Philippines, Thailand,
Mongolia, New Zealand and Australia in 1998.

ANSTO participated in an IAEA/RCA external dosimetry intercomparison organised by the Japan Atomic Energy Research Institute. Results of the second phase of the intercomparison indicated that ANSTO’s personal dosimetry service complies with international standards and is among the most accurate of the 32 national laboratories in terms of accuracy of measured doses.

ANSTO hosted the National Coordinators’ Meeting for the planned RCA project, ‘Radiation Sterilisation of Tissue Grafts’. Milestones, resources and outcomes for the next project phase were developed by 25 representatives from 16 countries. ANSTO also provided technical support at an RCA national training course, held in the Philippines, on radiation sterilisation technology.

ANSTO continued to support the activities of the RCA project on developing a nuclear information system, which was initiated to assist the sharing of information resources among RCA Member States. ANSTO provided fellowship training in information management, supplied libraries of the nuclear research institutes in the Asia-Pacific Region with Australian publications and ANSTO staff gave lectures. An ANSTO representative participated in expert group meetings to evaluate the outcomes and prepare the final report on the activities and achievements of the project. A new project proposal for 1997-2001 on sustainable nuclear information networks in RCA Member States was drafted and submitted for approval. The new project would focus on establishing a stable and sustainable communication and information infrastructure at the level of the national nuclear research institutes. It would be enhanced by training and co-operative agreements aimed at ensuring long term and efficient usage of the information infrastructure.

IAEA International Nuclear Information System

ANSTO is the Australian contact point for the International Nuclear Information System (INIS). During the year, 685 new Australian nuclear-related literature items were indexed and abstracted for inclusion in the IAEA’s INIS database. Since the system was launched in 1970, some 26,000 documents, authored by Australian scientists or published in Australia, have been included.

ANSTO staff provided the IAEA with advice and assistance in simplifying guidelines and mechanisms for INIS input and participated in the first phase of a project to revise the INIS record structure and cataloguing rules.

ANSTO’s INIS liaison officer attended a consultative meeting of INIS liaison officers in Vienna. Recommendations of this meeting included redefining the INIS record structure and subject scope, developing guidelines governing future distribution of the INIS CD-ROM, providing full text INIS non-conventional literature such as reports, standards, patents, and pre-prints, and possibly offering hybrid CD-ROM/Web access to INIS and more frequent updates. The copyright and licensing implications for INIS database production and distribution were also discussed.

As an INIS member, ANSTO has exclusive rights over the production, distribution and sale of the INIS CD-ROM in Australia. By undertaking the distribution on a cost-recovery basis, ANSTO has made the resource available to a large spectrum of Australian users at an affordable price.

OECD Nuclear Energy Agency involvement

The OECD Nuclear Energy Agency (NEA) has a membership drawn from countries advanced in nuclear developments. The NEA facilitates exchanges of information on nuclear developments in addition to promoting research on a range of nuclear safety and fuel cycle issues. Participation in NEA activities enables ANSTO to keep abreast of current trends and developments. ANSTO has direct access to the OECD document database in Paris and contributed to OECD/NEA programs on nuclear safety, radiation protection and public health, storage of spent fuel, nuclear science, and radioactive waste management. ANSTO’s Counsellors (Nuclear) in London and Vienna participated in several meetings of NEA Standing Committees and joint IAEA/NEA meetings.

An ANSTO representative attended the second meeting of the OECD Megascience Forum Neutron Sources Working Group in Interlaken, Switzerland. The Working Group adopted the European Science
Foundation report 'Scientific prospects for neutron scattering with present and future sources' as the authoritative OECD statement on the subject.

**Bilateral cooperation**

ANSTO is party to a number of bilateral cooperative arrangements including nuclear and scientific institutes in Japan, Korea, China, the United States, the United Kingdom, France and Russia.

As part of the Australian-France collaboration in nuclear biomedicine there were reciprocal scientific exchanges between experts from ANSTO and the Service Hospitalier Frederick Joliot in Orsay, France, to initiate joint research on the development of radiopharmaceuticals for the study of neurodegenerative disorders such as Parkinson's disease. Several meetings were held with the French Atomic Energy Commission within a project funded by the Department of Industry, Science and Tourism on environmental applications of accelerator mass spectrometry, the most recent being in Paris in October. The main aim of this collaboration is the application of long-lived radioisotopes to studies of natural analogues of possible radioactive repositories, with special reference to synergies between the NEA Analogue Studies in the Alligator Rivers Region project led by ANSTO and the Oklo project, an investigation of a naturally occurring fission reactor that existed in Africa about 1.8 billion years ago.

ANSTO continued cooperative activities with institutes in the United States, Japan, France and China in research and development activities associated with synroc waste management technology and advanced ceramics.

Collaboration was maintained with the Korea Atomic Energy Research Institute, particularly in the area of research reactor utilisation.

ANSTO hosted visits by two senior officers of the Indonesian National Atomic Energy Agency, BATAN, to advance collaboration between ANSTO and BATAN in the areas of waste management, safety infrastructure and environmental applications of nuclear science and technology.

ANSTO is represented on the Australian Steering Committee for Cooperation in Science and Technology between Australia and Indonesia. The Committee acts as a catalyst for strengthening science and technology cooperation between Australia and Indonesia and determines the roles and goals of a range of collaborative activities, currently in the fields of aerospace, automotive, biotechnology and telecommunications.

ANSTO was successful in its bid as a potential subcontractor to General Atomics in the United States for the design and construction of a multi-million dollar radioisotope production facility as part of a new nuclear research centre to be built for the Office of Atomic Energy for Peace in Thailand. The success of this bid provides recognition of ANSTO's leading position in radioisotope production in the Region.

**International Conference on Nuclear Cooperation in Asia**

Australia continued to support the activities of the International Conference on Nuclear Cooperation in Asia (ICNCA), whose membership comprises eight Nuclear Non-Proliferation Treaty Member States in our Region. The Australian delegation to the annual meeting in Japan in March was led by ANSTO's Director, Safety. In January, ANSTO hosted an ICNCA Nuclear Safety Culture Workshop in Sydney. Overseas participants were from Japan, Republic of Korea, China, Malaysia, Thailand, Indonesia, the Philippines and Vietnam. The discussion sessions were on the lessons being learned from safety culture programs in the Japanese and Korean nuclear power industries and the IAEA, and how these might be applied to strengthen safety culture in other nuclear activities. It was recommended that an ICNCA workshop on safety culture in research reactor operation be conducted in 1998.

ANSTO was represented in the neutron scattering component of an ICNCA workshop on research reactor utilisation held in Jakarta. The ICNCA cooperation in neutron scattering is to continue, making use of facilities in China, Malaysia and Korea, as well as those at Serpong in Indonesia as in the past. ANSTO staff also participated in ICNCA specialist workshops in the fields of public affairs and communications, and radioactive waste management.
Tokyo Nuclear Safety Conference

An ANSTO technical expert participated in the Australian delegation, led by the Department of Foreign Affairs and Trade, to the Tokyo Conference on Nuclear Safety in Asia in November. The Conference, convened as an initiative of the Japanese Prime Minister, provided a useful forum for the continuing development of regional cooperation on nuclear safety issues. Its themes were the safety of nuclear power plants and management of radioactive waste and liability in the case of nuclear accidents. The second such conference, to be held in Seoul, is planned for October 1997.

Emergency planning

ANSTO responded to a Yellow Alert in November when the National Emergency Plan for Satellite Re-entry (Complan-Spred) was activated by Emergency Management Australia (EMA) as a result of an out-of-control Russian satellite falling to earth. Subsequently ANSTO officers participated in an EMA meeting to revise the Complan-Spred and assisted in formulating clearer definitions of the roles of the various participating Government and Defence agencies.

ANSTO officers also provided, assisted with and tested monitoring equipment mounted in Department of Defence aircraft to assess and refine Australia’s capability to detect radioactive debris/ground deposition. This work took place at Department of Defence facilities in South Australia.

An ANSTO officer attended an EMA-sponsored meeting on National Disaster Mitigation Strategy. In April and May an ANSTO officer participated in a National Working Group to redraft the National Health and Medical Research Council Code of Practice on intervention in emergency situations involving radiation exposure.

Radioactive waste management

ANSTO provided technical advice to Government Departments and participated in meetings to develop an International Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. This has been drafted to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management through the enhancement of national measures and international co-operation. It will ensure that effective defences against potential hazards to individuals, society and the environment are taken into account during all stages of spent fuel and radioactive waste management. Adoption of the Convention will be considered at a diplomatic conference in September 1997.

ANSTO officers continued to participate on the Commonwealth/State Consultative Committee on the Management of Radioactive Wastes. ANSTO provided technical advice to the Commonwealth regarding the selection of one region for detailed investigation from the eight regions identified as possible sites for a national low level and short-lived intermediate level radioactive waste repository. The study is being undertaken by the National Resource and Information Centre. ANSTO is on record as strongly supporting the early establishment of such a repository.

Nuclear-powered warship visits

ANSTO provides a radiation monitoring service during visits of nuclear-powered warships (NPW) to Australian ports. A portable Early Warning System (EWS) was built in the early 1980s and while it continues to be highly reliable, it lacks the flexibility, data storage and communication abilities now required. ANSTO was commissioned to build and assemble new, fixed early warning systems for nuclear-powered warship monitoring. The new early warning equipment will be commissioned next financial year. A field trip to HMAS Stirling Naval Base was undertaken in October to identify any specific requirements related to installing new EWS instrumentation.

Seven NPW visits were serviced by ANSTO and four Visiting Ships Panel (Nuclear) meetings attended. The VSP(N) Working Group made port validation visits to Darwin, Brisbane, Melbourne, Hobart, Port Kembla and Gladstone. Emergency exercises were conducted in all ports visited by NPWs this year. ANSTO officers actively participated in a major port evacuation exercise held at Fisherman Islands, Port of Brisbane, in September.

The NPW biennial meeting of Commonwealth and State Organisations was held at Mount Macedon,
Victoria, in November. ANSTO officers participated in the preparation and presentation of this workshop and an ANSTO officer chaired the scientific sessions.

**Epidemiological study**

ANSTO is participating in an international project aimed at understanding the effects of exposure to low levels of radiation. A project progress report on the International Collaborative Study of Cancer Risk among Radiation Workers in the Nuclear Industry was presented to a study group of the International Agency for Research on Cancer, in Lyons, France, in March. Medical and personnel dosimetry data input for ANSTO and CSIRO personnel was completed in May.

**Safeguards**

The Australian Safeguards Office (ASO) conducted monthly inspections and audits of ANSTO’s nuclear materials and facilities. IAEA safeguards inspectors conducted four routine, quarterly inspections and two monthly inspections to verify ANSTO’s nuclear materials. As a result of the size of ANSTO’s current inventory of HIFAR fuel elements, IAEA inspectors increased the frequency of inspections to a monthly basis, commencing in April, in accordance with the IAEA’s safeguards criteria for this class of nuclear material. All inspections were considered satisfactory.

ANSTO continued to provide its in-ground spent fuel storage facility for a trial of remote monitoring equipment as a contribution to the enhancement of international safeguards. The trial is a cooperative project between ANSTO, the ASO and Sandia National Laboratories in the United States, (representing the US Department of Energy). Monitoring equipment developed in Australia has been added to the trial. The trial is expected to continue and include the IAEA Department of Safeguards in the next phase.

ANSTO is involved in IAEA programs, supported by the ASO, to develop new methods for environmental monitoring for nuclear safeguards. These procedures require the detection of long-lived fission products and actinide isotopes in environmental samples. Accelerator mass spectrometry techniques are used to detect iodine-129 and actinide isotopes in the environment.

Iodine-129 was measured for a round-robin inter-laboratory comparison exercise organised by the Lawrence Livermore National Laboratory (LLNL). The long-lived radionuclide iodine-129, a potential signature for reactor or reprocessing operations, was measured in samples of biota, waters and sediments to develop reliable analytical methods for environmental monitoring in nuclear safeguards. The ANSTO measurements agreed with the average values obtained by other laboratories.

An official from Uzbekistan spent a week at ANSTO in its Nuclear Safeguards Office. The visit was a follow-up to a two-week lecture and workshop course on nuclear material accountancy and control in the Republic of Uzbekistan, which had been given the previous year as part of the Australian Safeguards Assistance Program to the New Independent States of the former Soviet Union.

ANSTO was invited to contribute to a workshop on ‘The Status of Measurement Techniques for the Identification of Nuclear Signatures’ organised at the European Joint Research Centre of Geel, Belgium, by ESARDA, the European Union safeguards organisation. The ANSTO program on the use of iodine-129 for environmental monitoring in nuclear safeguards was presented at the workshop.

**Ministerial and other VIP visitors**

During the year, visitors to ANSTO included the Hon Tim Fischer MP, Deputy Prime Minister and Minister for Trade; the Hon Peter McGauran MP, Minister for Science and Technology; Senator Dr Bob Woods and Senator Christopher Ellison, Parliamentary Secretaries to the Minister for Health and Family Services; Mrs Danna Vale, Federal Member for Hughes; Ms Marie Ficarra MLA, State Member for Georges River; and Dr Francesco Catania, Consul General of Italy.
Drivers: Government, universities (through the Australian Institute of Nuclear Science and Engineering), other external customers and ANSTO.

OBJECTIVES

To operate core nuclear facilities in Australia and overseas for the benefit of the Australian research and development community and industry; and to enhance and improve the efficiency and effectiveness of these core facilities in order to yield high quality research, products and services. These facilities include the research reactor HIFAR, the National Medical Cyclotron (NMC), the Australian National Tandem Accelerator for Applied Research (ANTARES), the Australian National Beamline Facility on the Photon Factory in Japan and the beamline facilities at the Advanced Photon Source at the Argonne National Laboratory in the United States.
OUTCOMES

• The major national nuclear research facility, the HIFAR research reactor, was available for 94% of its scheduled available time to provide neutron beams for research, produce radioisotopes for medicine and industry and irradiate materials for researchers and industrial customers.

• HIFAR's quality management system was certified by an independent accreditation body as complying with the NZS/AS-ISO 9001 international standard.

• HIFAR's irradiation service for mineral ore samples and silicon produced an income of $2 million.

• ANSTO developed collaborative agreements with Australian and overseas institutions to promote the national and international recognition of the ANTARES Accelerator Mass Spectrometry (AMS) facility. ANSTO played a key role in Quaternary research and global climate science in Australia by providing accelerator mass spectrometry analysis of radiocarbon and other long-lived radionuclides to universities and other research institutions.

• The upgrade of the ANTARES tandem accelerator to higher energy and more reliable operating conditions broadened the range of research applications and expanded the base of possible users.

• ANSTO was the leading proponent on the successful Major National Research Facilities program proposal, which led to the establishment of the Australian Synchrotron Research Program (ASRP). This was incorporated as an association in December, with ANSTO as the managing agent. The ASRP now provides a comprehensive range of synchrotron X-ray research capabilities for Australian science in the fields of physics, chemistry, materials science, structural biology, polymer research, environmental science and geophysics. The other members of the ASRP are the Australian National University, the University of Sydney, the University of Canberra, the University of NSW, the University of Melbourne, Monash University, the University of Queensland, and the CSIRO.

• Major upgrades were made to ANSTO's National Medical Cyclotron with the design and installation of two new beam lines, one for Single Photon Emission Computed Tomography (SPECT) and the other for Positron Emission Tomography (PET) radioisotope production. The new beam lines are scheduled to begin operating in late 1997. Two new SPECT hot cells were also installed. These enhancements will further improve the reliability of supply, allow easier maintenance and minimise radiation exposure to staff.

ACTIVITIES AND OUTPUTS

HIFAR research reactor

Operation and utilisation

During the year the reactor operated for approximately 7,250 hours at an average power of 10.04 MW. Excluding the 13 scheduled shutdowns for fuel changes (totalling 51 days), the reactor was available for 94% of the scheduled operating time.

More than 8000 targets were irradiated in the reactor facilities for research and to produce medical and industrial radioisotopes. The reactor was also used to irradiate over 820 batches of silicon targets and over 20,000 mineral samples for commercial customers. The silicon targets are used in the manufacture of a wide range of products for the electrical and electronics industries.

University projects funded by the Australian Institute of Nuclear Science and Engineering (AINSE) utilised 383 instrument days, and internal ANSTO research utilised 215 instrument days. ANSTO research involving collaboration with university groups and training of PhD students utilised a further 161 instrument days.

Maintenance and support

The development of the HIFAR quality system was completed during the year. The external accreditation body, Quality Assurance Services Pty Ltd (the commercial arm of Standards Australia), undertook a full systems audit in March and concluded that the HIFAR quality system met all requirements for compliance with the NZS/AS-ISO 9001 International Standard. ANSTO received formal certification of the quality system in May. In addition to satisfying the requirements for the HIFAR Authorisation, the certification to the international standard has been well received by suppliers of silicon for irradiation in HIFAR.
A project was initiated to upgrade the level of fire protection. A number of fire fighting equipment points were established throughout the reactor building, cable penetrations between floor levels were filled with fire resistant pillows to limit the spread of fires and a contract was placed for a very early smoke detection system for the control room.

As part of the HIFAR coarse control arm life extension program, fatigue and radiation damage issues were reviewed. The review included an assessment of the loads and vibration frequencies which the arms will experience over their proposed life. It concluded that because the loads were so low, fatigue would not be of concern under normal operating conditions.

Twelve new bearings for the control arms were manufactured. The certification process required verification of raw materials used in the manufacture, in-process inspection of hardness, and dimensional and non-destructive testing of the bearing components.

A feasibility study for a major upgrade to HIFAR's polar crane recommended modernisation of the control system, replacement of the crane drives and rewelding of the crane track. Tenders were called for the design and implementation of these proposals. A new welding procedure, developed and trialed by ANSTO, was used by a contractor on the crane track, and this part of the crane upgrade was completed. The crane now operates more smoothly.

**Reactor analysis**

The consequences of loss of coolant flow accidents on HIFAR were reassessed. The results confirmed the previous conclusion that, in the extremely unlikely event of a failure to shutdown, there would be no release of fission products from the fuel.

A flow visualisation system was installed on the ANSTO water tunnel test rig. This will enable quantitative measurements of the flow field in models simulating HIFAR fuel elements and irradiation rigs. This facility will also provide a means of validating computational fluid dynamics (CFD) simulations and provide results in complex geometry not amenable to CFD.

The computer software used for simulating neutron transport was upgraded by installing the latest version of the Monte Carlo Neutral Particle code. This version also accesses the most recent international nuclear data. The graphical display of results from ANSTO's deterministic neutronics computations was enhanced by adding a plotting capability with a graphical user interface.

**Probabilistic Safety Assessment and Remaining Life Study**

One of the main recommendations of the Research Reactor Review in 1993 was to perform a Probabilistic Safety Assessment (PSA) and Remaining Life Study (RLS) of HIFAR. A Technical Reference Committee was set up by the Department of Industry, Science and Tourism to manage these studies. ANSTO's Director, Safety, is a member. The work was awarded to PLG, a US-based company with extensive experience in such studies. ANSTO staff from different disciplines worked together to provide the committee with the information needed by PLG.

The PSA/RLS performed on HIFAR is one of the most comprehensive studies ever performed on a research reactor. It covers potential equipment failures and includes the determination of relevant safety criteria, as well as consideration of seismic and human factor issues. It is due for completion in late 1997.

**Neutron scattering**

The neutron scattering group provided beam time on five instruments to holders of 21 AINSE Research and Training grants and four AINSE postgraduate students and assisted with data processing and interpretation (544 instrument days in total). Collaborative research in areas of mutual interest continued with university groups. The majority of AINSE work involves fundamental studies of interesting materials, such as high temperature superconductors, giant magneto resistance materials and catalytically active metal oxides. Some of the work, for example measurement of residual stress or analysis of Portland cement, will benefit industry.

A neutron scattering workshop was organised by AINSE in October and attracted more than 50 participants. This included a forum on the future of neutron scattering, including neutron sources and instrumentation.
The upgraded 2TanA diffractometer became fully operational. Data from it were used in a collaborative project with Sydney University to solve a crystal structure which had previously defied solution using X-ray or neutron data. Data were collected on the same material at a low temperature (60°K), using the newly commissioned cryogenic attachment of this instrument. It is expected that the differences between the two structures will reveal relationships between hydrogen bonding and thermal vibrations.

Work began on upgrading the Long Wavelength Polarisation Instrument (LONGPOL). The installation of new hardware and software and a digital signal processor was completed. The first supermirror polariser for the LONGPOL instrument, made to ANSTO’s design at the Hahn-Meitner Institut, Berlin, and supported by Australian Research Council infrastructure funds, was received and tested. A polarisation of 96% was achieved (previous polarisation was ~40%), and the reflectivity was only slightly below the predicted value. These improved characteristics increase the quality and quantity of data available from this instrument, which has special applications in the areas of magnetic order, fluid dynamics in high temperature superconductors and crystal field studies.

ANSTO, in collaboration with Australian universities, is in the process of adding the Small Angle Neutron Scattering instrument (AUSANS) to the suite of experimental facilities available on HIFAR. The area detector for AUSANS passed all preliminary tests and was filled with gas to design pressure. The acquisition of the first two-dimensional test pattern on the AUSANS area detector was a major achievement for a multi-disciplinary team of scientists, engineers, technicians and computer programmers. While the integration of the detector into the instrument hardware is in progress, various aspects of the science made possible by the SANS technique are being explored. An additional set of multilayers for the instrument was manufactured, using thin metal film technology, at Brookhaven National Laboratory in the United States.

In collaboration with Newcastle University, and following a suggestion from CSIRO, neutron diffraction patterns were recorded from a number of tetragonal zirconias fabricated by researchers from the Korea Institute of Science and Technology. The work has led to a recognition of the structural systematics in tetragonal zirconias, and an understanding of the chemical forces determining the stability and structures of these industrially important ceramics.

Commercial facilities for neutron transmutation doping of silicon

ANSTO irradiates single crystals of silicon in HIFAR for overseas customers to enhance the electrical properties of the silicon. Several modifications were made to the existing facilities used for neutron transmutation doping of silicon in HIFAR to enhance reliability and improve product quality. These changes resulted not only in higher quality material, but also in safer, easier and more efficient operation of the facilities, and a further reduction of the already low radiation doses to operating personnel. Two new facilities were commissioned, and accepted by our customers, for routine operation.

As part of the silicon irradiation program, a large number of silicon wafers were annealed and their electrical resistivity checked as a quality assurance measure. A new, more compact and efficient measurement system was constructed to allow automation of resistivity measurement.

All customers reported that irradiations were of consistently high quality and that lead times for return of shipments had been significantly reduced.

Radiation protection

The Nuclear Safety Bureau carried out an audit of health physics at HIFAR and concluded that ‘radiation protection at HIFAR was observed to be generally satisfactory’.

Health physics staff made significant progress in establishing the angular response and neutron detection capability of the ANSTO thermoluminescent dosimeters (TLDs) used to measure radiation doses to workers. This has led to more accurate estimates of doses to HIFAR staff.

MOATA

The low power Moata research reactor was shut down in 1995 and fuel and cooling water were
removed in 1996. During the year it was decided that Moata should be permanently decommissioned and a project management team was formed to plan and carry out this task. Three stages of decommissioning are envisaged: post operational care with fuel removed (current status), partial dismantling with continuing care, and complete dismantling. Work began on preparing a schedule for the plan.

ANSTO engineers have been looking at the feasibility of including Moata fuel in a proposed HIFAR fuel shipment to the United States in 1998. Preliminary work showed that it would be possible to include the Moata fuel with the shipment of HIFAR fuel.

The National Medical Cyclotron

The National Medical Cyclotron (NMC) operated by ANSTO, is a major national facility, providing isotopes for research, clinical evaluations and routine nuclear medicine procedures. It is located on the site of Sydney’s Royal Prince Alfred Hospital, which it supplies with very short-lived isotopes such as F18-fluorodeoxyglucose.

The NMC’s two major commercial products, gallium-67, and thallium-201 are sold under the Australian Radioisotopes (ARI) trademark to public and private nuclear medicine centres throughout Australia and overseas.

During the year, major upgrades were made to the Cyclotron production facilities. ANSTO staff designed, built and installed two new beam lines for the irradiation of Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET) targets. The new beamlines are scheduled to begin operating in the second part of 1997. Two new SPECT hot cells were also installed. These enhancements will provide the capacity to meet expected growth in demand, further improve the reliability of supply, allow easier maintenance and minimise radiation exposure to staff.

All PET cell door hinges were tested, using the magnetic particle test. This is a preventive measure against cell door failure and improves operational reliability. Routine inspection of Faraday cup components, copper targets and the water cooling system manifold was carried out.

Two additional SPECT laboratory cells were inspected for conformance with specifications. Dimensional inspection of PET beam line components and the solid target transfer duct were completed.

Research projects undertaken during the year included the development of a methodology to recover copper-64 from the production process streams. This was successfully trialed and small quantities of the copper-64 isotope were produced for use in research activities. Work also began on a project to produce indium-111, which has diagnostic and therapeutic applications in nuclear medicine.

The NMC continued to develop quality systems for accreditation under the Australia/New Zealand ISO 9000 series. It already complies with the quality assurance guidelines of the Therapeutical Goods Administration and the Codes of Good Manufacturing Practice.

Accelerators for scientific and industrial research

ANTARES tandem accelerator

Several major elements of the accelerator structure were upgraded during the year to improve both the energy stability and the focal properties of the particle beam. The most significant upgrades were the installation of new accelerator tubes and a recirculating gas stripping system. As a consequence, operation at terminal voltages of eight million volts is now possible. Modern components have replaced outdated technology in all key areas, increasing reliability and reducing downtime. Additional computer interfacing, improved beam diagnostics and expanded safety systems simplified operation and enhanced safety. Work began on installing a new Alphatross ion source, which will produce high-intensity beams such as alpha particles, not available with the existing sputter source. The source is expected to be operational next year. The new Pelletron charging system, expected to be installed in late 1997, will enhance the terminal voltage stability, which is of vital importance to the heavy ion microprobe and the AMS actinide beamline.
Accelerator mass spectrometry

The ANTARES Accelerator Mass Spectrometry (AMS) facility performs ultrasensitive analysis of the long-lived radioisotopes carbon-14, beryllium-10, aluminium-26, chlorine-36 and iodine-129. Radiocarbon analysis is the most frequently used capability. During the year, ANSTO used AMS/carbon-14 dating to measure the ages of a diverse range of specimens from Italian archaeologists including ancient human bones, charcoal and ancient artefacts. It established a collaboration with the Japanese National Institute for Resources and Environment (NIRE) to measure the radiocarbon content of ocean waters and sediment traps. ANSTO continued to collaborate with the Australian National University to measure the age of commercially important fish stocks through the radiocarbon content of fish otoliths and, in collaboration with the University of Sydney, measured about a hundred consecutive, single tree ring samples from a 12,000-year-old Tasmanian Huon pine. A highlight was the radiocarbon dating of the Iron Crown of Charlemagne, the first Holy Roman Emperor.

The ANSTO AMS Centre for Quaternary Science is used by AINSE-sponsored researchers from over 30 Australian universities. For the fourth year, funding for AMS analysis in Quaternary science projects came from the Australian Research Council (ARC) Research Infrastructure Equipment and Facilities Program. University researchers use AMS predominantly for radiocarbon measurements. The advantages of the facility are that it provides ultra-high sensitivity, allows the use of small sample mass, and requires short measurement time. More than 1,000 radiocarbon samples were analysed for university projects funded by AINSE and ARC.

Work continued on improving quality and throughput in measuring carbon-14 and other long-lived radionuclides. A new method for isolating fossil pollen from lake sediment was established and procedures were developed for the preparation of bone samples. A new procedure for processing beeswax was developed and used for dating Aboriginal rock art from the Kimberley region of Western Australia. Collaborations continued with researchers at James Cook and Queensland Universities and at the Texas A&M University in the United States to develop techniques to prepare the very small samples associated with Aboriginal rock art.

An experiment to characterise preparation procedures for AMS radiocarbon targets was carried out and the results presented at the 16th International Radiocarbon Conference at Groningen, Holland. Work began on establishing a new chemistry laboratory to process samples for AMS analysis of cosmogenic radionuclides such as beryllium-10, chlorine-36 and aluminium-26.

New and improved beamline components were commissioned. A Wien filter, which uses a combination of electric and magnetic fields to select ions of a unique velocity, was commissioned for the analysis of carbon-14. An electrostatic analyser, which uses an electric field to select ions on the basis of their mass and charge, was commissioned to analyse iodine-129. The isotope bouncing system, which permits quasi-simultaneous measurements of isotopic ratio, is now routinely used with all radioisotopes commonly measured at the ANTARES AMS facility. This is a pulsed voltage technique whereby isotopes can pass through the injection magnet and into the accelerator without the magnetic field being changed.

The design of an AMS beamline for the detection of actinides was completed and its construction begun. High resolution electrostatic/magnetic analysers were purchased. Construction of a new clean laboratory dedicated to the preparation of actinide samples neared completion.

Ion beam analysis

ANSTO’s accelerator capabilities include a range of ion beam analysis techniques such as time-of-flight methods using the high energy, heavy ion beams produced by the tandem accelerator. This research involved five PhD and several MSc students as well as numerous honours and undergraduate students. The wide range of research topics included high energy neutron and fission physics; materials, surface and interface studies; radiation damage; atmospheric pollution; archaeometry and semiconductor research.

A heavy ion microprobe is being installed on the
ANTARES accelerator. This new facility will generate micron-sized beams of high energy, heavy ions such as iodine and chlorine for materials analysis, surface characterisation and interface profiling. A beamline is being assembled to house triplet focussing magnets. Beam brightness measurements were performed to provide essential input data for beam transport calculations. Work also commenced on the design of a versatile target chamber for mounting and manipulating samples to be analysed. This facility is scheduled for completion in 1997/98 and, after commissioning, will be available for microanalytical characterisations of a variety of solid materials. The heavy ions microprobe will complement ANSTO's other microanalytical facilities, which include secondary ion mass spectrometry (SIMS), scanning and transmission electron microscopes, and the synchrotron X-ray microprobe.

The combined number of operational days provided for ion beam analysis to university researchers (for both the 3 MV Van de Graaff and the Tandem accelerators) in 1996 was over 200, and spanned 27 projects. This represents an increase in usage of about 25 per cent over the previous year. Demand for these facilities from external users and researchers remains strong, with 32 AINSE projects being approved for 1997. These projects cover topics ranging from high technology materials to environmental and biological research, and radiation dosimetry. In most instances, the interactions have produced successful outputs in the form of joint published journal and conference papers.

Both the 1996 and the 1997 AINSE Gold Medals for research were awarded to PhD students using 'time-of-flight' methods on the ANTARES tandem accelerator.

During 1996 and 1997 the ANSTO accelerators and their associated analytical techniques were part of undergraduate teaching programs at Macquarie University and the University of NSW. Students came to ANSTO as part of their course work to learn about the physics of accelerators and their applications to everyday problem solving. This proved a most popular and worthwhile course, giving students firsthand experience in a research environment.

Australian Synchrotron Research Program

The Australian Synchrotron Research Program (ASRP) provides Australian researchers with access to state-of-the-art synchrotron radiation research capabilities at overseas synchrotron light source facilities. These are the Australian National Beamline Facility (ANBF) at the Photon Factory, Tsukuba Science City, Japan, and the Advanced Photon Source (APS), recently completed at the Argonne National Laboratory near Chicago in the United States. The ASRP is funded for five years under the Major National Research Facilities program, beginning 1 July 1996.

The ASRP maintains two staff to operate the ANBF at the Photon Factory and will appoint three staff to be based at the APS from the beginning of the next financial year. The ASRP staff are ANSTO employees. In addition, Australian researchers using the facilities receive ASRP funding for travel and subsistence. Access is via a peer reviewed process.

The ASRP is managed by ANSTO under the direction of a Policy and Review Board supported by an Executive Committee and a number of specialist committees. Membership of the Policy and Review Board is drawn from the member institutions of the ASRP which currently comprise ANSTO, CSIRO, the Australian National University, the University of NSW, the University of Sydney, the University of Melbourne, the University of Queensland, and Monash University. The University of Canberra is an associate member.

Australian National Beamline Facility

The ANBF operated for only eight weeks during the year, due to an extended shutdown of the Photon Factory for a major performance upgrade. The Photon Factory is scheduled to re-start operations in November 1998, with the brightness of the synchrotron X-ray beams increased by a factor of five. The ANBF hosted 15 user groups during the short operations period, including two from ANSTO's Materials Division, and three collaborations involving its Physics Division staff.

Development of the ANBF experimental facilities continued. A range of sample environment cells were commissioned and used. These included
heating stages, a tensiometer, an electrochemical cell and a computer controlled multiple sample stage.

The Advanced Photon Source, Argonne National Laboratory

The APS provides beams both at much higher energies, and at a brightness thousands of times higher than that available at the ANBF. The ASRP has provided funding towards the construction costs incurred by the three consortia building beamlines at the APS, in return for a share of the operation and use of the facilities. The consortia are the Biological Consortium for Advanced Radiation Sources (BioCARS), which specialises in protein crystallography; the Chemistry and Materials Science Consortium for Advanced Radiation Sources (ChemMatCARS), which provides X-ray scattering and diffraction facilities for chemistry and materials science research; and the Synchrotron Radiation Instrumentation Collaborative Access Team (SRI-CAT), which will provide a wide range of capabilities for physics, chemistry, geophysics and environmental science research.

The SRI-CAT facilities became operational and proposals for the use of these facilities have been accepted from Australian researchers. The BioCARS facilities will be operational from early 1998, and the ChemMatCARS beamlines will be fully operational in 1999.

Nuclear science is being used to wage a campaign to contain one of Australia's most destructive horticultural pests, the Queensland fruit fly. For State agriculture authorities, ANSTO uses a gamma radiation source to irradiate fruit fly pupae in an effort to flood wild fruit fly populations with sterile males. Staff members Gavin Gant and Victor Mestre are pictured at ANSTO's GATRI (Gamma Technology Research Irradiator) facility, used to irradiate the pupae when they are exactly eight days old.
ANSTO continued its involvement in an international program monitoring long-term trends in concentrations of pollutants in the atmosphere. ANSTO's David Garton is pictured at Cape Grim, Tasmania, with a high sensitivity detector developed by ANSTO for the program.

Drivers: Government, other science organisations such as the Australian Antarctic Division, the Bureau of Meteorology, the Australian Geological Survey Organisation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities and industry.

OBJECTIVES

To apply nuclear-based techniques to research projects in support of national and international programs, such as investigations of global climate change and environmental pathway analysis, and to applied studies driven by industry and government.
OUTCOMES

• ANSTO's research contributed to revision of the Australian and New Zealand Environment Conservation Council water quality guidelines. This is the first time that ANSTO's expertise and data in metal speciation and bioavailability has been recognised in setting international water quality objectives. This expertise was further acknowledged by appointment of a staff member to the national technical committee overseeing the revision process.

• ANSTO's unique capabilities for accelerator mass spectrometry and ion beam analysis continued to contribute to international knowledge of global climate change and environmental science. A study of particulate air pollution in the Jakarta region was completed. This project, in collaboration with CSIRO, studied the composition of fine particles smaller than 10 micrometers in diameter which are the source of Jakarta's ubiquitous haze.

• An independent review of the ANSTO-managed Alligator Rivers natural analogue studies was carried out by the US Nuclear Regulatory Commission. This found that the project 'would be useful for others evaluating the potential for uranium migration in sub-surface environments and the associated risks at sites being considered for radioactive waste disposal and decommissioning'. Firm expressions of interest by the German Institute of Nuclear Safety (GRS) and the Czech Nuclear Research Institute to join the project are further recognition of its value.

• Five new strategic research projects were initiated, using nuclear science and technology to understand environmental dynamics and global climate change. These projects will strengthen links and collaborations with a number of partners.

• Use of ANSTO's Secondary Ion Mass Spectrometer (SIMS) by Australian university researchers increased by 50 per cent. It was used to analyse mineral surfaces, biological systems (especially archival records of metal contamination), semiconductors, and coatings and ceramics.

• ANSTO, in collaboration with the Australian Institute of Nuclear Science and Engineering (AINSE), hosted a national workshop on the use and application of SIMS for the surface analysis of materials. The workshop provided a forum for defining the direction of SIMS research in Australia and how it may complement other surface analysis techniques to provide a better understanding of surfaces.

• A high precision gamma transmission gauge was designed and constructed to measure sediment loadings at depths of up to 100 metres with a precision of 0.3 per cent, together with a range of other parameters. It is being used to support ANSTO's research using nuclear science and technology to understand offshore processes. One of the gauges, manufactured in association with Amdel Ltd and Minekin Australia, was supplied to Morocco through the International Atomic Energy Agency (IAEA).

ACTIVITIES AND OUTPUTS

Grant support from the Australian Institute of Nuclear Science and Engineering (AINSE) was 12% more than in 1996, when the amount included a one-off AINSE/Australian Research Council infrastructure equipment grant of $130 000 for the SIMS facility.

Environmental dynamics - application of nuclear techniques

Strategic research based on modelling of two-phase, turbulent flow and subsequent model validation using radiotracer measurements and technology aims to understand sediment and contaminant transport in the coastal zone. An enhanced understanding of anthropogenic inputs to the sea through man-made and natural systems obtained by such research aims to contribute to sustainable development of the coastal zone. Collaborators on the project include the CSIRO, the University of NSW, Sydney Water and the NSW Environment Protection Authority.

Global climate change - application of nuclear techniques

Three strategic research projects in this field were initiated to contribute to the knowledge of climate
change over the past 500,000 years. The projects focus separately on gathering and interpreting archival information from sediments and from Antarctic ice cores, and on interpreting the surface exposure history of rocks. They involve collaboration with CSIRO, the Antarctic Division and a number of universities. A fourth project, which is on global baseline air pollution, will help scientists to predict future climate change, validate global transport models, and evaluate the effects of fine particles and aerosols on global temperatures. Project collaborators include the CSIRO and the Bureau of Meteorology, with ANSTO contributing with its pioneering work in radon studies and its unique capabilities in accelerator-based ion beam analyses.

**Atmospheric fine particle aerosol research**

ANSTO continued to provide, with the CSIRO, consultancy services to the CSS Joint Venture Group (CMPS&F, Sinclair Knight Merz and Sagric International) in the study of fine atmospheric particles and gases in the Jakarta region. The CSS Joint Venture Group is implementing the Indonesian Environmental Protection Agency (BAPEDAL) and East Java Pollution Control Implementation Project in Indonesia for AusAID.

The objectives of the current study are to determine the major sources of atmospheric particles and the contributions of different natural and anthropogenic sources to the fine particulate burden in the Jakarta region. The results will be used to guide Indonesian authorities in assessing the health and environmental effects of local and regional air contaminants and in evaluating the effectiveness of control programs.

ANSTO operated five sampling units at four selected sites in and around Jakarta city and applied accelerator-based ion beam analysis techniques to characterise the atmospheric aerosol in two different size fractions. CSIRO is studying the effects of atmospheric gases (SOX and NOX) and the light scattering and visibility effects of the atmospheric particulate loading.

ANSTO, in conjunction with CSIRO Division of Atmospheric Research, is currently conducting a pilot study of atmospheric fine particles in Australia. This study, funded by Environment Australia, is determining the range of fine particle chemical and physical properties in Sydney, Melbourne, Brisbane, Hobart, Adelaide and Canberra. Sample collection in the first three locations was completed this year with the latter three scheduled for completion in 1997. ANSTO's expertise is being used in the siting of air sampling equipment and in multi-elemental ion beam analytical facilities for the characterisation of aerosol filtered particles.

The ANSTO Aerosol Sampling Program (ASP) currently operates 10 fine particle sampling units for local councils, State environment protection authorities and industry groups. ASP units are operating in Wollongong, Sydney, Newcastle, the Hunter Valley and the Brisbane metropolitan area.

ANSTO ASP units continued to operate in Singapore (three units), California and New Zealand.

**Neutron scattering measurements**

Small angle neutron scattering data were recorded from a number of activated charcoals to define the pore size distribution in these materials and thereby understand their function in removing taste and odour molecules from water. The measurements were made in collaboration with the Cooperative Research Centre in Water Quality and Treatment in Adelaide, initially using the NG3 small-angle neutron scattering instrument at the National Institute of Standards and Technology at Gaithersburg in the United States. Later measurements used the powerful D22 small-angle diffractometer at the Institut Laue-Langevin, Grenoble.

**Use of radiotracer techniques to evaluate sewage outfall**

ANSTO was retained to undertake two further investigations of sewage dispersion in waters off Hong Kong in association with the Water Research Laboratories (WRL) of the University of NSW. This and related client-commissioned work is being supported by a strategic research project on Environmental Dynamics. Particular attention has been paid to the complex processes which occur close to the diffuser heads through which the sewage is released to the ocean. An essential element of the collaborative program with the WRL is the extension of the near field modelling capabilities and the use of radiotracer techniques to...
validate the models.

In a related investigation, modelling capabilities have been extended to include the impact of storms on the movement of sand. It is proposed to verify the models by measuring the transport of sand at depth over a one-year period using iridium-192, which has a half life 74 days. Monitoring will occur after major storms.

**Secondary Ion Mass Spectrometry (SIMS) facility**

The SIMS facility is used to study surface interactions of pollutants with biological, geological and man-made materials. During the year, SIMS capabilities were used to support the Analogue Studies in the Alligator Rivers Region natural analogue project, which is evaluating the migration of uranium in the vicinity of ore bodies as natural analogues of the geological strata hosting radioactive waste facilities. SIMS evidence contributed to the demonstration of an important mechanism for retaining uranium in iron nodules dispersed in the weathered zone of the Koongarra deposit in the Northern Territory. This work, instigated by the Japan Atomic Energy Research Institute, was greatly extended by collaboration with the ion Microprobe Group of the Australian National University. The Sensitive High Resolution Ion Microprobe at the Australian National University is capable of measuring very low levels of key radionuclides. This was the first time these measurements had been done with iron and associated clay and quartz minerals and the technique may well find wider application.

ANSTO completed a hardware and software upgrade of its SIMS facility. ANSTO used the facility to study fluid pathways in materials representing natural analogues of waste repositories, bio-indicators of water quality and water quality record, and the leaching characteristics of synroc. This work is reported under the individual projects. During the 1996 calendar year ANSTO managed an Australian Research Council infrastructure grant on behalf of AINSE, which provided resources to support university measurements on the SIMS facility. The grant resulted in an increase from 11 to 16 university SIMS projects with ANSTO.

In April, ANSTO, in collaboration with AINSE, ran a two-day workshop on SIMS applications. It attracted 68 specialists in surface analysis techniques and applications, and included two overseas speakers. Reports were presented on the use of SIMS for the surface analysis of minerals, biological systems (especially archival records of metal contamination), semi-conductors, coatings and ceramics.

**Radon research**

Research focused on the transport of the naturally occurring radioactive gas, radon, and radon decay products in the atmosphere and porous media.

ANSTO continued to participate in an international program monitoring long-term trends in concentrations of anthropogenic pollutants in the atmosphere. ANSTO-developed high sensitivity radon detectors operated at Cape Grim, Tasmania, Macquarie Island and, in cooperation with the US Climate Monitoring and Diagnostic Laboratory, at Mauna Loa Observatory on the Island of Hawaii. A new detector, capable of continuous monitoring of radon-222 and radon-220 decay products in air, successfully completed its first year of operation at the Cape Grim Baseline Air Pollution Station.

ANSTO continued to participate in the first Characterisation Experiment (ACE-1) of the International Global Atmospheric Chemistry Project. The aim of the project is to record the chemical, physical and radiative properties, and to determine the controlling processes, in the remote marine atmosphere. Staff assisted with the second phase of the project, which was devoted to data processing and interpretation and construction of a project-related database.

The research project sponsored by Australian Coal Research Ltd, aimed at the development of a new method of predicting outbursts of gas, coal dust and small coal fragments in underground coal mines, continued with a deployment underground of a pair of radon detectors. The first results have already validated assumptions made in the planning phase of the project concerning expected absolute and incremental radon levels in underground air.

**Use of long-lived radionuclides to understand natural processes**

ANSTO continued to work on a collaborative project with the CSIRO Division of Marine Research to develop the necessary chemistry procedures to use...
AMS to analyse carbon-14 in seawaters. ANSTO will utilise these procedures in the World Ocean Circulation Experiment. This program depends primarily on the measurement of the physical and chemical properties (such as the carbon-14 concentration) of the water column by oceanographers from many countries. The final goal is to understand the influence of ocean circulation on the world’s climate.

In collaboration with European Union partners, carbon was extracted from uranium ore samples to measure the so-called heavy radioactivity: the emission of carbon-14 clusters from nuclei in the trans-lead region.

ANSTO is collaborating with French and Italian groups involved in studies of the Oklo natural reactor sites in Gabon, Africa, with a view to applying AMS to trace the migration of radionuclides in natural analogue systems. Iodine-129 and chlorine-36 are presently being analysed in water samples from Oklo.

ANSTO, together with AINSE and the Australian Museum, organised the 6th Australasian Archaeometry Conference. It focused on issues related to the first human colonisation of the Australian continent. The application of nuclear science and technology in archaeology and palaeoecology was also discussed.

Isotope analysis of metabolic rates in endangered species

Measurements of the oxygen-18 enrichment levels in biological tracers are now routinely carried out using nuclear reaction analysis on the 3MV Van de Graaff accelerator. This work, done in collaboration with the Department of Zoology at the University of Western Australia, underpins the research carried out into the metabolic rates of a wide range of endangered native fauna. The specialised habitats for these endangered species are shrinking rapidly, and an understanding of the caloric requirements, essential for the survival of these species, forms part of a State conservation program.
Above: Dr Laurie Aldridge, left, and Kevan Harder with the equipment for mixing cement grout used to make simulated, fullscale stabilised radioactive waste forms. The durability of these simulated waste forms is then tested at ANSTO.

Right: ANSTO technician Bruce Hudson operates equipment used in the conversion of uranium and thorium into a stable form.
CORE BUSINESS AREAS

TREATMENT AND MANAGEMENT OF MAN-MADE AND NATURALLY OCCURRING RADIOACTIVE SUBSTANCES

Lyn Tan examines the performance of a uranium thickener during the operation of a pilot plant to demonstrate the process flowsheet for the Kintyre uranium project in Western Australia.

Right: A new racking system for storing low level radioactive waste until it can be transferred to a national low level waste repository was commissioned at ANSTO during the year. David Maher, waste management operator, forklifts a 200 litre drum into storage.

Drivers: Government, ANSTO and industry

OBJECTIVES

(a) To provide government with expert scientific and technical advice on nuclear waste management, including environmental impacts of uranium mining.

(b) To refine or develop new technological approaches for immobilisation and disposal of radioactive waste and minimisation of environmental contamination from the nuclear and mining industries.

(c) To provide environmentally sensitive and cost-effective waste management in accordance with relevant standards and appropriate risk management strategies.
OUTCOMES

• ANSTO's world class expertise in radioactive waste immobilisation was demonstrated by the US Department of Energy's decision to short list synroc as an option for the immobilisation of excess weapons-grade plutonium. Following publication in the United States of the 'Programmatic Environmental Impact Statement' in December and the subsequent 'Record of Decision' in January, two contracts, worth $US180 000, were awarded to ANSTO to provide demonstrations of its proprietary technology. The results of these demonstrations, which included sending two hot isostatically pressed cans of synroc to the United States, are to be used as input in the waste-form selection process. The final decision on the selected waste-form is expected in the second half of 1997.

• ANSTO scientists, working with the NSW Department of Land and Water Conservation, provided advice to the Commonwealth Department of Primary Industries and Energy on the role of the biological crust that covers the soil surface at the former nuclear test site at Maralinga. The Department was advised that the crust plays an important ecological role in the desert environment, decreasing dust generation, providing nutrients to the soil and enabling larger plants to re-establish themselves in areas where contaminated soil has been removed and buried.

• The process flowsheet for the Kintyre uranium project in Western Australia was demonstrated in a pilot plant at the Lucas Heights Science and Technology Centre. Laboratory-scale studies were also undertaken to obtain data for use in the preparation of the Environmental Impact Statement for the project.

• Metallurgical studies provided data that will be used in designing process circuits for the expansion of the treatment plant at the Ranger uranium mine in the Northern Territory.

• Work programmed for this financial year on ANSTO's five-year Waste Management Action Plan, was completed on schedule. The Plan, initiated in the previous financial year, will ensure that, by the year 2000, ANSTO fully conforms to new waste management standards being developed by the International Atomic Energy Agency.

• Management of radioactive waste on site was enhanced through the introduction of new monitoring and storage facilities. A facility for measuring the radioactivity of ANSTO's solid wastes was commissioned. Over 1,000 drums were scanned and the information stored in a computerised database. On-site facilities for storage of drums of low level radioactive waste were upgraded.

• A plant was commissioned to stabilise finely-divided uranium and thorium metallic scrap by controlled oxidation in a rotary calciner. The plant has operated routinely for six months and about two tonnes of uranium metal have been stabilised.

• A process was developed to solidify the intermediate-level liquid waste from production of radiolabels for medical use. The process was tested successfully using simulated non-radioactive waste solutions.

ACTIVITIES AND OUTPUTS

Synroc

Work continued on developing the synroc process for immobilising high-level radioactive waste. ANSTO maintained links with key organisations involved in high-level radioactive waste management in all countries pursuing commercial reprocessing of spent fuel. Such links provide the basis for cooperation in potential commercial waste remediation and provide ANSTO with access to research facilities unavailable in Australia, in particular for accelerated testing of the resistance of synroc to radiation damage from alpha-decay of long-lived radionuclides. The results of joint research continue to provide independent confirmation of synroc as an advanced second generation waste-form.

ANSTO continued to participate in the United States' assessment of the immobilisation of surplus weapons-grade plutonium by collaborating with the Lawrence Livermore National Laboratory (LLNL). The laboratory was assigned the lead role by the US Department of Energy for assessing and developing
immobilisation technologies. ANSTO has provided specific data and demonstrations of synroc under contract to LLNL to provide inputs into a Programmatic Environmental Impact Statement (PEIS) on Long-Term Storage and Disposition of Weapons-Usable Fissile Materials.

Experience gained at the non-radioactive synroc demonstration plant at ANSTO and the resulting conceptual radioactive plant designs by ANSTO were used by the LLNL to develop flow-sheets for ceramic immobilisation of plutonium for the PEIS. The collaboration with LLNL on surplus plutonium immobilisation has been reported in recent ANSTO Annual Reports.

The final PEIS was published by the US Department of Energy in December. On 14 January, US Energy Secretary O'Leary made a Record of Decision calling for a dual approach to the disposition of surplus weapons-usable plutonium, namely immobilisation of surplus plutonium in glass or ceramic, and burning of some of the surplus plutonium as mixed-oxide fuel in existing reactors.

The PEIS process and the Record of Decision reflect a thorough examination of the options for near-term implementation of surplus plutonium disposition. The initial technical assessments, which covered technology maturity as well as quality of the waste-form, dealt with more than 40 candidates.

Following this Record of Decision, ANSTO obtained two further contracts from LLNL. One contract is for ANSTO to demonstrate its technology to produce synroc in cans by hot isostatic pressing and the ability of the technology to be scaled up for production. The other is to demonstrate the flexibility of synroc formulations to immobilise impurities that are expected to be present in the plutonium.

Cans of high-quality synroc containing non-radioactive simulants of plutonium have been delivered to the LLNL. The results of these recent contracts will have an important influence on the US Government's decision, expected in the second half of 1997, on whether to choose synroc or glass for plutonium immobilisation.

Contacts were maintained with the consortia of nuclear engineering companies actively involved in the remediation of tank wastes from past defence projects at Hanford in the United States. The current focus is on the use of synroc to immobilise separated technetium and caesium waste streams. These radionuclides are volatile during vitrification, which requires an oxidising environment. Experiments were concluded at ANSTO to demonstrate near-complete (better than 99.9%) retention of caesium and technetium during synroc processing.

Negotiations were initiated for a Cooperative Research and Development Agreement (CRADA) with the Argonne National Laboratory (ANL) in the United States to demonstrate the use of a hot isostatic press to produce high-level radioactive waste-forms in a hot-cell environment. Under the CRADA, ANSTO would demonstrate its proprietary can technology for use with ANL wastes and, in return, ANL would demonstrate the production of synroc in a hot cell facility. The formal agreement is expected to be finalised in the second half of 1997.

The joint program of research into the synroc process, carried out under a collaborative agreement with the Japan Atomic Energy Research Institute, continued on schedule. The program continued to focus on radiation damage and its impact on leach rates.

ANSTO continued to collaborate with the French Atomic Energy Commission on basic studies of waste-form durability and on the application of cold-crucible technology to processing synroc for wastes from advanced reprocessing. The collaboration was extended to cold-crucible melting of a synroc/glass composite waste-form developed at ANSTO for the solidification of high level radioactive waste sludges at Hanford in the United States.

ANSTO also continued to cooperate with SIA Radon, in Moscow, under a letter of intent signed with the Russian Ministry of Atomic Energy, Minatom, on the evaluation of synroc waste-forms designed for Russian waste immobilisation using their cold-crucible technology. A scientist from Radon visited ANSTO for joint experiments, reciprocating an earlier visit by ANSTO staff to Russia.

ANSTO hosted a visit by scientists from the Chinese Institute of Atomic Energy. Joint experiments were conducted on synroc containing simulated Chinese waste. This cooperation occurred under a
Memorandum of Understanding between ANSTO and the China National Nuclear Corporation.

Access to unique major international research facilities has provided ANSTO researchers with new insights into aspects of chemical design and radiation damage of synroc. The Australian National Beamline Facility at the synchrotron in Tsukuba, Japan, was used to obtain high-resolution X-ray diffraction data from synroc phases. Co-operative research on the Stanford synchrotron facilities in the United States provided new results about the solid-state chemical speciation of actinides, including plutonium, in synroc. The combined transmission electron microscope/ion irradiation facility at the Argonne National Laboratory permitted study of the progressive changes in synroc phases caused by radiation damage, important information to contribute to regulatory acceptance of any waste form.

Cement waste-forms

Cement-based waste-forms are widely used to encapsulate low- and intermediate-level radioactive wastes. Within ANSTO’s waste management plan, cement is intended for the encapsulation of some historical wastes, including those from the production of medical isotopes. Work began on a study to investigate the durability and resistance of cement waste-forms to leaching by groundwater to develop predictive models of their behaviour over periods of about 300 years, by which time all the shorter-lived radionuclides would have decayed to safe levels.

The investigation is mainly focused on domestic cementitious materials and additives such as blast-furnace slag, pulverised fuel ash, silica fume and superplasticisers that are used to tailor and enhance desired properties of cements for different waste streams. Cement products vary from country to country as a consequence of variations in raw materials and thus a study of Australian cementitious materials is essential. Innovative small-angle neutron scattering experiments were performed at overseas neutron facilities to study the cement microstructure, which has an important role in the durability of cement. The appropriate neutron scattering facilities are not available at ANSTO, and the research has been facilitated by support from the Department of Industry, Science and Tourism under the International Research Collaboration grant scheme.

A study of caesium retention in both French and Australian cement formulations was undertaken under a co-operative research agreement with Electricité de France (EdF). Under the agreement, EdF sponsored a French post-doctoral student to work at ANSTO for 10 months.

Uranium ore processing

A pilot plant to demonstrate the process flowsheet for the Kintyre uranium project in Western Australia was built and successfully operated. The demonstration involved leaching of high-grade ore, selective removal of impurities and precipitation of uranium using hydrogen peroxide. About 12 tonnes of ore was processed in seven campaigns, each involving continuous operation for five to six days. Uranium recovery was high and the process was shown to be robust. Valuable data were obtained for the design of a commercial plant. Laboratory-scale studies were also undertaken to provide technical information on the environmental impact of the process and the characteristics of the wastes. This information will be used in the preparation of the Environmental Impact Statement for the project.

A number of metallurgical studies were carried out for Ranger Uranium Mines. These included research on recovery of uranium from highly weathered ore which is difficult to process. Laboratory-scale studies were also carried out to determine uranium recovery from the Ranger No. 3 orebody. The studies involved hydrometallurgical testing of 30 different ore types from various sections of the mine. Data from the studies are being used in the design of process circuits for mill expansion.

Strategic research was undertaken to better understand the factors controlling the dissolution of uranium and other minerals in commercial leaching circuits. The study aims to develop a mathematical model to describe the leaching kinetics of uranium minerals, which can then be applied to determine the optimum processing conditions for a given ore type.
Maralinga

ANSTO participated in an industry-funded assessment of the wasteform produced by the in situ vitrification process being trialed in the area previously used for weapons testing at Maralinga, South Australia. ANSTO's investigations have focused on the durability of the resulting glass/ceramic wasteform and its ability to immobilise plutonium.

HIFAR spent fuel

Following the successful shipment last year of 114 spent fuel elements to the Dounreay facility of the United Kingdom Atomic Energy Authority, the elements were reprocessed. To complete the requirements attached to the environmental approval of the shipment, a final monitoring report covering all phases of the shipment and reprocessing was prepared and submitted by ANSTO to Environment Australia. The report demonstrated that all commitments given in the Public Environment Report (PER) for the shipment were met and that all assumptions in that report regarding potential radiation exposures and potential environmental impact were modelled with a large degree of conservatism: actual measured impacts were considerably below even those low impacts estimated in the PER.

ANSTO completed a submission to the Australian Maritime Safety Authority and the Australian Radiation Laboratory to have its purpose-built spent fuel transport flask re-certified. A criticality safety assessment was completed to allow the flask to be used to ship all design variants of HIFAR fuel elements with 150g or less Uranium 235 content. When the submission is approved, it will be forwarded to US authorities for review and approval.

ANSTO continued to keep Government informed on the situation regarding the inventory of spent fuel stored at Lucas Heights, on the options available for the disposition of this spent fuel and on the need for early action to address these options.

Currently available options are to ship the spent fuel elements back to their country of origin for reprocessing or disposal, or to establish a domestic capability to process spent fuel elements and manage the resulting wastes. As aluminium clad spent fuel inevitably degrades over time, it is an unsuitable form for long-term storage or ultimate disposal and must eventually be processed to place the wastes into a stable wasteform.

As at 30 June 1997 Australia is holding some 1630 spent HIFAR fuel elements. The original source of the enriched uranium was approximately 60:40 UK origin to US Government origin. Government decisions on the above options for the future disposition of the spent fuel are pending.

Monitoring of spent fuel storage facilities

ANSTO has an in-ground spent fuel storage facility with a capacity for 1100 spent HIFAR fuel elements inside 50 sealed stainless steel tubes. During the year, an improved method for monitoring the gas space in the tubes was developed. Systematic monitoring of the humidity and composition of the gas indicated that most of the elements were stored in a dry condition. However, in some tubes, the high relative humidity suggested that water could be present. Further investigations confirmed the indications of water in a few tubes.

The spent fuel in the tube with the largest quantity of water was removed and inspected. The onset of corrosion of the aluminium cladding was apparent in some elements. Examination of the stainless steel tube showed it to be in good condition and fully sealed. The source of the water was identified as rainwater that had entered the top of the tube due to a degraded gasket seal. New gaskets have since been fitted on all 50 tubes.

The conclusion from these investigations, subsequently reported to the Safety Review Committee and the Nuclear Safety Bureau, was that, despite the presence of water, the facility performed its designed purpose of isolating the spent fuel from the environment and the spent fuel continues to be stored in a safe and secure manner. Further and more comprehensive monitoring of the fuel storage facility is planned in the coming year.

Waste management action plan

The Waste Management Action Plan was initiated to implement ANSTO's waste management policy. By the year 2000 ANSTO aims to be in full conformity
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with new waste management standards being developed by the International Atomic Energy Agency (IAEA). The first phase of the Plan, completed in 1996, was a technical review of ANSTO’s waste management operations and practices. That review made 24 recommendations for implementation over a five-year period.

The Waste Management Action Plan is an inter-Divisional activity outside ANSTO’s routine waste management activities. The plan is updated regularly in accordance with priorities and needs. Currently, it consists of 17 tasks covering management of ANSTO’s solid and liquid wastes, spent fuel and effluents.

Solid waste management

ANSTO’s facilities for storage of drums containing low-level radioactive wastes were upgraded. The drums are now stored on racks to improve safety and ease of access. The new racking system has capacity for 5,700 standard drums and 1,000 oversized drums.

A state-of-the-art radiation scanning facility was commissioned to carry out a complete inventory of ANSTO’s solid wastes. Standard 200 litre drums are placed inside a shielded cabinet and rotated while radioactivity is measured by three gamma-ray detectors. Another system with one detector is used for items that are of non-standard size or have a higher level of radioactivity. To date, over 1000 of ANSTO’s inventory of about 5,000 drums have been scanned. The activity of all identified radioisotopes is stored in a computerised database.

Some four tonnes of uranium and thorium metallic scrap have accumulated over the past 35 years from the melting, casting and machining of uranium and thorium. The metals are pyrophoric and have been stored under kerosene to prevent spontaneous combustion. A plant was commissioned to stabilise these waste materials by controlled oxidation in a rotary calciner. It has operated routinely for six months and more than two tonnes of uranium scrap have been converted to a stable oxide. Conversion of the remaining scrap is scheduled for completion by the end of 1997.

Liquid waste management

ANSTO has about 6,000 litres of intermediate-level liquid waste from the production of radioisotopes for medical use. These wastes are stored in a shielded facility containing eight tanks, five of which contain liquid waste. During the year, inspection of the facility indicated that some valves needed to be replaced. A new valving manifold system was designed and will be installed in the near future. In addition, a new system to improve monitoring of the tanks was designed and is being installed.

A process was developed to solidify the intermediate-level waste. It involves evaporation, treatment to remove ammonium ions and to reduce the acidity of the solution and then crystallisation as an uranium salt. The process was tested successfully using simulated non-radioactive waste solutions. Treatment of the actual radioactive solution will be carried out in a hot cell. Design and installation of equipment for the hot-cell is in progress.

The solid waste will be suitable for interim storage, although immobilisation in a non-leachable form is a longer-term goal. Two waste forms have been considered, synroc and cement. Laboratory-scale quantities of synroc and cement have been prepared containing simulated waste. The chemical durability of zirconolite-rich synroc containing up to 20% uranium was found to be particularly good and comparable with standard synroc. In contrast, the initial cement batches were relatively easily leached and further work with different formulations is being undertaken in order to improve cement quality.

Organisational issues

The Waste Management Action Plan is being implemented under a Quality Management regime based on the International Standard Organisation standard, ISO 9001. A quality plan was prepared, giving details of the responsibilities, authorities and procedures to be followed.

A waste minimisation working party was formed with the goal of reducing the quantities of radioactive waste through a number of measures, including volume reduction, segregation at source and adoption of cleaner production technologies. A number of opportunities for waste minimisation were identified for more detailed examination.
Team members of the Managing Mine Wastes Project installing environmental equipment at the Mt Lyell site in Tasmania.

Inset: High precision rocket cans, manufactured by ANSTO workshop staff, are used in the HIFAR research reactor in the production of the fission product molybdenum-99. This product is used in generators that yield a reliable supply of technetium-99m for diagnostic purposes.

Drivers: Government and industry

OBJECTIVES

(a) To contribute to the development of critical technologies aimed at enhancing the competitiveness and ecological sustainability of selected industry sectors by applying nuclear science and technology and ANSTO’s unique mix of technical capabilities.

(b) To provide scientific and technical advice and services to government and industry, based on radiation and other relevant standards, radiation safety, radiation sterilisation, and plant assessment technologies.

(c) To supply internationally competitive radioisotopes and radiopharmaceuticals for medical, industrial and environmental use in Australia and the Asia Pacific region.
OUTCOMES

Environmental management

• A process for oxidising and immobilising arsenic was successfully demonstrated in Montana in the United States. The waste satisfies the standard US leach test for landfill disposal.

• A study was completed for the Office of the Supervising Scientist on the extent of acid mine drainage in Australia. The study found that the cost of managing potentially acid-generating waste at operating Australian mines sites is about $60 million a year and drew attention to the importance of adopting control measures at the outset of the mining projects.

• ANSTO scientists participated in a project for the Co-operative Research Centre for Waste Management and Pollution Control aimed at improving the design of landfills for municipal waste. A 7000 tonne test cell was operated at the Lucas Heights, Sydney, landfill. By operating the test cell with recycle of leachate, a marked increase in waste degradation was observed.

• ANSTO completed a collaborative project to develop remedial technologies to detoxify polluted harbour sediments. The suite of chemical, biological and mineral processing technologies developed successfully removed contaminant metals to regulatory levels. The technologies are applicable generically to metal-contaminated sediments, soils and wastes.

• An ecological risk assessment of copper in Macquarie Harbour, Tasmania, highlighted the shortcomings in current Australian water quality guidelines and existing assessment methodologies as well as the inconsistencies between laboratory based ecotoxicological data and more realistic field-acquired information. The experience gained is being used to develop a relevant Australian ecological risk assessment model for freshwater systems affected by mining.

• ANSTO field-validated a Korean mathematical model for describing stack emissions of radioactive and other gases. The methodology was based on the ANSTO-developed technique of using perfluorocarbons as inert gas tracers.

• ANSTO’s field data on air quality in the Jenolan Caves showed that the presence of tourists was not affecting air quality. The data will be used to assist the Jenolan Caves Trust in developing the caves as a tourist attraction.

• ANSTO made further improvements to its geochemical computer codes and coupled them with an international hydrology and mass transport code. ANSTO has applied these codes as computational tools for modelling the release of surplus water from the Ranger uranium mine site in the Northern Territory. ANSTO, in association with the University of Technology, Sydney, held a five day training course on the use of these codes for the environmental industry.

• A project to characterise the environmental impact of the primary and supergene waste materials from the Ernest Henry mining project in Queensland was completed. The information will be used by the company in its design of a post mining rehabilitation program.

• ANSTO designed, installed and commissioned a set of discrete level depth samplers in the flood irrigation area of the Ranger uranium mine. The samplers will provide the company with the necessary environmental monitoring data to understand the geochemical processes in ground waters and flood irrigation conditions.

• ANSTO demonstrated a concept developed by Earth Systems Pty Ltd for sealing porous media by induced mineral precipitation. The concept has potential application in the control and prevention of contaminant release.

• In a world-wide intercomparison exercise organised by the National Research Council of Canada for the US National Oceanic and Atmospheric Administration (NOAA), involving 40 laboratories, ANSTO's environmental analytical chemistry facility was accorded 'Superior Laboratory' status for the analysis of major and minor chemical elements in soil, sediments and biological samples. Only 15 laboratories were awarded this status.

• ANSTO scientists developed a technique for environmental analysis of individual metal species in waters and waste streams.
• ANSTO scientists determined that the maximum level of radioactive caesium in Australian honey is 0.01 times the radiological safeguard limit and is generally at the limit of detection. The results reflect the lower radiological levels of radioactive caesium in the southern hemisphere compared to the northern hemisphere.

• Some 15 million pupae of Queensland fruit fly per week were irradiated for NSW Agriculture in ANSTO's gamma irradiation facility (CATRI).

Mineral processing

• A pilot plant was successfully operated to demonstrate a new solvent extraction process for recovering nickel and cobalt from solution. The project is now proceeding to the full design and construction stage.

• The use of membranes to separate organic and aqueous phases in solvent extraction was shown to be a viable concept and was demonstrated by extracting and recovering cerium, a rare earth, using laboratory-scale equipment containing two membranes.

Industry

• ANSTO's gamma irradiation facilities processed health care materials, tissue grafts, biological material and polymers for 38 clients comprising health care facilities, importers, researchers and industrial scale manufacturers at a range of temperatures and dose rates.

• ANSTO provided calibration, supply and measurement services for 16 industrial dosimetry clients and blood irradiation facilities.

• Window modules up to 10 cm x 10 cm coated with nano-titania photovoltaic films were produced on schedule and delivered for testing under the Energy Research and Development Corporation funded project with Sustainable Technologies Australia Ltd, Monash University and the Australian National University. Potential applications include installation on high rise buildings where the windows would supplement the electricity supply. ANSTO's contribution was the development of the titania nanopowder and film deposition technology, which was based on technology developed for the synroc project.

• A prototype hermetically-sealed ceramic housing for implantable medical devices was produced in conjunction with Cochlear Ltd under a three-year Industry Research and Development grant from the Department of Industry, Science and Tourism.

• ANSTO's technology, developed for the Plasma Immersion Ion Implantation process, received international recognition with the sale of a high-voltage pulser to the Research Centre for Surface Engineering at the University of Hull in the United Kingdom. ANSTO's technology was chosen over that of competitors as it was perceived to be closest to commercial application and had the most sophisticated instrumentation and control system.

Safety services

• By disseminating Australian standards of radioactivity measurement, ANSTO enabled radiopharmaceutical producers and nuclear medicine departments and clinics to routinely make measurements and ensure the accuracy of patient doses.

• ANSTO safety specialists identified the lowest risk option for transport of radioactive slurry by the Rhône-Poulenc company in Western Australia. This resulted in approval being given for the operation and significant savings accruing to the company.

• Advice was provided by ANSTO on a major new mining development to ensure that radiological safety aspects were acceptable. As a result, the relevant regulatory authorities were satisfied with the proposed radiological aspects, and the mining operation is to commence in the 1997/98 financial year.

ANSTO's pioneering work on Digital Coincidence Counting led to the establishment of a collaborative research agreement with the National Physical Laboratory (NPL) in London.

Radiopharmaceuticals and industrial isotopes

• Research led to the development of a matching pair of radiopharmaceuticals with potential to evaluate and treat advanced breast cancer. The diagnostic version, which consists of a compound
labelled with technetium-99m, will be evaluated in a clinical trial to commence in late 1997. In the therapeutic version, technetium-99m is replaced by rhenium-188, which emits radiation that can destroy cancer cells. This will be evaluated after completion of the trial of the diagnostic agent.

- ANSTO scientists developed a process to produce indium-111 in the National Medical Cyclotron (NMC). Production at the NMC would eliminate the need to import indium-111, which is used for labelling radiopharmaceuticals used to diagnose gastro-intestinal and other cancers. It is also used to radiolabel white blood cells for use in monitoring infection.

- Revenue from radiopharmaceuticals and radioisotopes for medical, industrial and research use rose by 1.6% to $12.3 million.

ACTIVITIES AND OUTPUTS

Environmental management

Arsenic treatment

The presence of arsenic in groundwater is a serious problem in many countries. It can result from natural processes or from industrial activities such as the mining of arsenic-bearing ores.

A research group at ANSTO, funded by the Cooperative Research Centre (CRC) for Waste Management and Pollution Control Ltd, has developed a process to oxidise arsenic and convert it into an environmentally-stable solid. The patent for the photo-oxidation process has been granted by the Australian Patent Office and the World Intellectual Patent Organisation. It is pending in Europe and North America.

This oxidation-immobilisation process was demonstrated in Montana in the United States as part of a project funded by the US Environmental Protection Agency. Three ANSTO officers, in collaboration with staff from a US Department of Energy contractor, MSE Incorporated, performed a pilot-scale demonstration project to treat smelter flue dust and acid mine drainage water from an abandoned gold, silver and lead mine near the town of Helena. The arsenic from the waste streams was successfully photo-oxidised and immobilised into solid wastes. Testing of the waste showed that it satisfied the standard United States leach test for landfill disposal.

Acid mine drainage

Control of pollutants in effluent from sulfidic mine wastes continues to be a problem facing regulators and mine operators both in Australia and overseas. A goal in managing sulfidic mine wastes is to quantify the load and concentration of pollutants in effluent at different times after deposition of the wastes. ANSTO continues to make significant advances in the field of acid mine drainage, based on its growing understanding of physical and geochemical transport processes in the environment.

ANSTO worked as part of an international team of experts to assist PT Freeport Indonesia in developing an overburden management plan for the Grasberg copper/gold mine in Irian Jaya, Indonesia. Through the deployment of field measurement techniques, ANSTO quantified rates of sulfidic oxidation and identified the principal rate-controlling mechanisms.

Instrumentation has been installed in two sulfidic waste rock dumps at the Mt Lyell copper mine in Tasmania to assess the effectiveness of measures which have been put in place to control the generation of acid mine drainage. The work has been funded by Copper Mines of Tasmania Pty Ltd and Environment Tasmania.

ANSTO undertook a scientific review of documents for the United States Department of Environmental Quality concerning environmental research and proposed work at Golden Sunlight Mines in Montana in the United States. Special attention was paid to the generation and control of acid mine drainage.

Improved landfill design and operation

The difficulty of obtaining acceptable landfill sites for disposing of municipal wastes is a major problem confronting local and State governments. ANSTO is a partner in a project funded by the CRC for Waste Management and Pollution Control Ltd to develop technology for the rapid degradation and stabilisation of the bioreactive component of municipal solid waste. The project is managed by the Waste Service NSW and utilises the Lucas
Heights, Sydney, landfill to demonstrate the CRC technology. A key component of this technology is the recycling of leachate to promote rapid decomposition of the waste.

The first test cell was constructed at the Lucas Heights landfill site in August 1995 and filled with 7000 tonnes of waste, roughly the amount of garbage produced by an average Sydney suburb in one year. ANSTO is responsible for operating and monitoring the leachate recycle system, and for interpreting the results. The methane composition of the biogas reached the optimal 60% within nine months. Core samples taken from the test cell after two years showed accelerated physical degradation of the waste compared with that obtained in a conventional landfill after 10 years.

**Remediation of dredged estuarine sediments**

The generic technical problem of how to effectively detoxify sediments and soils co-contaminated with heavy metals and toxic organic chemicals is receiving much attention world-wide. The disposal of contaminated harbour sediments after dredging constitutes a difficult environmental problem, particularly in Australia, where landfill sites able to receive large volumes of contaminated material are non-existent.

A project aimed at developing remedial technologies to treat co-contaminated sediments was completed. Harbour and estuarine sediments from Sydney Harbour and the Parramatta and Cook's Rivers were used as a model system. ANSTO collaborated on the project with CRA Advanced Technical Development (ATD), Sydney Water, and Patterson Britton and Partners Pty Ltd. The work was partly funded by the Department of Industry, Science and Tourism through the provision of a Generic Industrial Research and Development grant of $412,400.

The project involved a multidisciplinary approach that started with the undisturbed sediment bed and finished with the disposal of waste streams. Major components of the research program included (i) selection of target sediments based on chemical analysis of sediments sampled from 21 sites in Sydney Harbour and Parramatta and Cooks Rivers; (ii) physical, chemical and ecotoxicological characterisation of harbour/river sediments from five sites; (iii) development of mineral processing techniques to reduce the volume of material to be treated and increase the efficacy of treatment; (iv) development of both biological and chemical processes to remove heavy metals from the sediments to required residual levels; (v) assessment of the efficacy of bioremediation of polynuclear aromatic hydrocarbons in the sediments; and (vi) ecotoxicological evaluation of process liquid and solid waste streams.

Process flow sheet development and preliminary costing of full scale plant construction and operation was finalised. A successful bench-scale trial of the technology was conducted on sediment from a large scale industrial contaminated-sediment dump.

**Plume tracing**

ANSTO has developed the use of the inert perfluorocarbon gases as tracers for tracking gas plumes and for defining local meteorological conditions. The technique attracted overseas interest and during the year a collaborative program with Seoul National University and the Korean Meteorological Research Institute was completed. The program provided the experimental data necessary to validate a Korean mathematical model. The model is to be used to provide air pollution impact assessments from a proposed nuclear power station in Korea. The work was presented at conferences in Australia, Korea and China. Collaboration with the Korean Meteorological Research Institute is continuing. The techniques were also used to complete 70 industrial consultancies on the nature, quality and quantity of gaseous emissions. An undergraduate honours research project employing the technique to study the air quality in Jenolan Caves was completed.

**Environmental geochemistry**

ANSTO carried out theoretical geochemical studies on disposing of surplus water by spray irrigation at the Ranger uranium mine, Northern Territory. The studies involved identification, quantification and validation of factors controlling the movement of the water; conversion of these factors into a model representing the transport; and calculation of the transport rates with identification of possible release modes such as evaporation, spring water, and overland flow. This particular site required a realistic
description of the oscillation of the water table with the wet and dry season, a task not previously attempted. The work was reported at an open workshop organised by Energy Resources of Australia/Ranger Uranium Mines. The theoretical modelling is being validated by the collection of field data from the site using a set of ANSTO-designed discrete level water samplers. This phase of the project has a further year to run. A further set of discrete level water samplers has been installed on the flood irrigation site on the slopes of Coonjimba Creek.

The work has allowed continued development of chemical codes and the coupling of these codes with hydrological and mass transport codes. These form a new generation of coupled codes for environmental impact assessment of pollutant transport. This work is being undertaken in collaboration with Professor Zheng of the University of Alabama, author of the mass transport code, MT3D. ANSTO, in collaboration with the National Groundwater Centre, University of Technology, Sydney, organised a five-day workshop and course on the application of these codes to predict the extent of pollutant transport from a site.

ANSTO continued a series of geochemical studies using column tests on behalf of the Ernest Henry mining project, Queensland. The studies provide the geochemical data required to develop a sound environmental plan for the project and forms part of ongoing environmental studies for the project.

ANSTO, in collaboration with the World Geoscience Corporation, completed an analysis and report on the airborne gamma ray capability of the ENMOS airborne monitoring system. The analysis used the facilities of the ANSTO remote monitoring laboratory.

ANSTO demonstrated a concept proposed by Earth Systems Pty Ltd for sealing porous media by induced mineral precipitation. The technique has considerable potential for preventing contaminant release from mine and industrial sites and for the controlled channelling of pollutant plumes to treatment areas. ANSTO, in collaboration with Earth Systems, is actively pursuing further development of the concept.

Hydrology of waste rock dumps

A significant environmental problem in the mining industry is the transfer of pollutants from sources such as waste rock dumps into the surrounding ecosystem. As water is usually the main carrier of the pollutants, an integral part of being able to control and limit environmental pollution problems of this nature is an understanding of how water moves through media such as waste rock dumps. ANSTO, in collaboration with ERA Environmental Services, carried out field experiments at the southern waste rock dump at ERA's Ranger mine site to investigate water flow patterns in the dump. The experiments and subsequent analysis showed current models and understanding to be inadequate, and further research to be necessary.

These findings are also of importance to the field of acid rock drainage, a major pollution problem at many mine sites in Australia and other countries, as well as to the process of heap-leaching, a method of extracting metals from low-grade ores by irrigation.

Analytical chemistry

ANSTO participated in the USA National Oceanic and Atmospheric Administration program for the analysis of major and minor chemical elements in soil, sediments and biological samples and in the Australian National Association of Testing Authorities Waters Proficiency testing programs for waters. These programs are undertaken to allow participating laboratories to gauge and improve their analytical precision and accuracy. The ANSTO laboratory gained 'Superior Laboratory' accreditation.

ANSTO scientists researching the separation and analysis of chemical species presented the first reported analyses of individual arsenic species in waters and waste streams at an international conference organised by the Royal Australian Chemical Institute, the Australian Society of Ecotoxicology and the Society of Environmental Toxicology and Chemistry. The technique and results generated considerable interest from industry, instrument manufacturers and universities, and there is an active program pursuing further development of the concept, both with instrument manufacturers and with university analytical
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chemistry departments.

Radioanalytical chemistry

ANSTO completed an analysis program on the level of radioactive caesium in Australian honey in order to provide a comparison for results obtained by European researchers. The level was found to be generally at the limit of detection and the maximum concentration found was 100 times less than the radiological safeguard concentration. These results are a reflection of the lower radiological levels in the southern hemisphere compared to those in the northern hemisphere, where caesium levels in honey can exceed the radiological safeguard limit.

As part of a continuing program of quality management, the environmental radiochemistry laboratories have been refurbished to bring them to ISO 9000 standard. The laboratory Instructions and protocols are being rewritten in the ANSTO Procedures Manual format and a laboratory information management system has been commissioned to permit full sample tracking during analysis.

ANSTO co-supervised two undergraduate honours projects on contaminant chronologies and sediment movement in local waterways.

Mineral and downstream processing

Processing of materials containing trace quantities of radioactive isotopes

Quantitative measurements of the level of naturally-occurring radioactivity (uranium and thorium) in products derived from mineral sands continued to be provided as a service to industry. The measurements are necessary to allow mineral sand products to be exported to countries and customers that place limits on radioactivity content. Industry-funded work also continued on the removal of naturally-occurring radioactive contaminants from local mineral products to increase their competitiveness in world markets.

Processing of anode slimes

In the electro-refining of copper, anode slimes containing high levels of precious metals are produced. Western Mining Corporation (WMC) operates an anode slimes processing circuit at their Olympic Dam plant in South Australia. This process comprises a series of hydrometallurgical and pyrometallurgical steps, to remove various impurities such as lead, copper, selenium, tellurium and polonium, which are necessary to produce high quality refined gold and silver.

The expansion in production at Olympic Dam will require a new anode slimes processing circuit. WMC commissioned ANSTO to re-examine the present flowsheet with the aim of reducing operating and chemical costs. The first part of the project has been completed and various options have been identified for further investigation.

Solvent extraction of metals

Solvent extraction is a key technology, developed for the nuclear industry, which is finding wider application in the recovery of metals such as copper, nickel, cobalt, rare earths and gold.

ANSTO’s strategic research on solvent extraction focussed on the use of membranes to separate organic and aqueous phases. This technique reduces the volume of solvent and eliminates the emulsions and crud that sometimes form when phases are dispersed. Using two membranes, extraction and recovery of cerium was successfully demonstrated. Further research and development on this technique will be carried out to develop a modular system with higher throughputs.

ANSTO undertook research and development for Resolute Ltd on a process to recover nickel and cobalt from solutions derived from the Bulong nickel deposit in Western Australia. This work culminated in the operation of a pilot plant at ANSTO involving 20 stages of solvent extraction, followed by electrowinning of nickel. The project was run jointly by ANSTO and Resolute Ltd. Other participating organisations included Mintek (South Africa) and Bateman Kinhill Kilborn. The pilot plant campaign was very successful and the project is now proceeding to the final design and construction stage.

Radiation technology

Gamma irradiation facilities were audited and found to comply with licensing requirements of the Therapeutic Goods Administration and the
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Australian Quarantine and Inspection Services. Materials processed for quarantine purposes included biological material requiring storage and irradiation under frozen conditions.

Several modifications and a refurbishment were completed on ANSTO's GATRI facility and work commenced on three other gamma irradiation facilities. The modifications will provide a greater choice of facilities for processing quarantine, biological and health care materials and for the anticipated expansion of the sterile insect project from 1997.

Some 15 million Queensland fruit fly pupae were irradiated each week as part of the sterile insect program for NSW Agriculture as part of the Tri-State Fruit Fly Strategy. The Fruit Fly factory, a facility recently commissioned by NSW Agriculture, is capable of producing 25 million such pupae per weekly production cycle.

Industry

Nuclear instruments and methods for polymer characterisation

ANSTO and the Cooperative Research Centre for Polymers jointly organised a workshop to explore ways in which ANSTO capabilities could be applied to solve problems in polymer research and to assist Australian industry. ANSTO staff gave presentations on a range of nuclear and accelerator techniques such as neutron scattering, ion beam analysis and synchrotron radiation, which can be applied to the characterisation of polymer structure. The workshop involved members of the polymer research community from CSIRO, Monash University, the CRC for Polymers and some representatives from Australian industry.

Advanced ceramics

The functional ceramics work at ANSTO is based largely on sol-gel science and technology developed originally to provide improved routes for the production of synroc precursor. Work continued on adapting sol-gel technology to a range of non-nuclear applications, including the production of thick and thin films for protective coatings, dielectric, piezoelectric, photovoltaic, photochromic and sensor applications, and controlled porosity structures for filters and burners.

A new multidisciplinary research project began on the engineering and chemical functionalising of surfaces for designer materials. The project is focusing initially on optimising the Interface for low-temperature ceramic/ceramic and metal/ceramic joining.

Ceramic microspheres, with controlled porosity, are also being developed for the delivery of radioisotopes and radiopharmaceuticals.

In a collaborative program with the French Atomic Energy Commission, the ultrastructure of sols used in synroc and sol-gel processing was investigated using the advanced small angle X-ray and neutron scattering facilities at Saclay, France.

Materials assessment

ANSTO maintains a strong capability for structural integrity assessment of materials and components to ensure the continued safe operation of ANSTO's nuclear plant and equipment. This expertise and the associated facilities are the basis for ANSTO's cooperation with industry. The main activities during the past year were:

A major three-year project with Pacific Power was completed. The outcomes of this project were the development of creep-fatigue based methodologies to assess pressure equipment operating under cyclic conditions. Specific algorithms were developed for one particular superheater header in a NSW power station. The project resulted in the development at ANSTO of a unique facility for performing stress-relaxation tests on miniature samples taken from operating pressure equipment.

Commercial work included creep tests on materials from the Australasian power and petrochemical industries. The results are used to assess the remaining life of components which operate at high temperatures and pressures. Other commercial work included ultrasonic and fatigue tests on spot-weld configurations for a major Australian manufacturer to underpin its bid for substantial export contracts to the United States; mechanical testing of copper samples from large electric motors; and the assessment of the metallurgical condition of a number of process vessels for a chemical company. A large testing and evaluation program continued with a major Australian non-ferrous metal manufacturer.
ANSTO continued to participate in a number of projects as a core partner in the Cooperative Research Centre (CRC) for Materials Welding and Joining, using capabilities required to maintain nuclear plant. Two projects were completed and a further four commenced.

The two completed projects were on cold-cracking in the heat-affected zone of welds, which involved detailed finite element modelling (with BHP Flat Products Division), and on welding of thermally modified structures, which was aimed at quantifying the effects of repair welding in aged pressure equipment (with the University of Wollongong, the CSIRO and BHP Flat Products Division).

Of the four new projects, two involve the critical assessment of girth welds in thin-walled gas pipelines as part of a major research program with BHP Flat Products Division, the Welding Technology Institute of Australia and support from the oil and gas pipeline industry. Other projects are on the asset management of rail bridges subjected to fatigue (with the Universities of Wollongong and Adelaide) and the life estimation of welded pressure equipment operating at elevated temperature (with the University of Wollongong, BHP Flat Plate Division and the support of several Australian and international organisations in the power industry).

Progress was made in developing an algorithm for reconstructing ultrasonic data to improve the characterisation of defects in structures and welds. A prototype array transducer was constructed, and tests demonstrated the superiority of the new algorithm's image-enhancing capability over more conventional techniques. Further optimisation of the algorithm and the array transducer are planned. The ultimate aim is to enhance existing capabilities in the area of reactor component inspection.

**Surface engineering**

The Plasma Immersion Ion Implantation (PI3) process for improving wear resistance and service-life of tool materials and components continued to attract international interest. A number of industry, university and government research organisations have been assessing variants of the process. Negotiations were advanced with an Australian organisation which submitted a proposal and business plan for a licence to manufacture and market the technology to the scientific and industrial research community. An agreement is close to being finalised.

Evaluation of the PI3 technique as a surface treatment for cutting-blades in the food-processing industry commenced. Initial results proved encouraging, with treated blades lasting three to four times longer and exhibiting superior cutting performance.

Collaboration with the Technical University of Clausthal, Germany, continued on a study of the response of a range of stainless steels to variations of the PI3 process.

A strategic study of the mechanisms of nitriding in low-pressure plasmas was completed. This was carried out in collaboration with the University of New England with the support of an Australian Research Council grant. The results of the study provide guidance for optimising the use of such plasmas to treat materials and components which cannot be nitrided by conventional techniques. A custom-designed, hot-walled vacuum furnace was constructed by an Australian manufacturer to allow the process to be trialed in a near-industrial environment.

**Interface phenomena**

The Japanese-funded international joint (NEDO) program, in which ANSTO collaborated, was completed. The project involved an investigation of the surface properties of zirconia. A general model of gas/solid processes for an oxygen/zirconia system was formulated, the effect of alioivalent ions on surface reactivity of zirconia with oxygen was determined and the kinetics of incorporating some specific ions into zirconia were studied.

Research with a commercial partner, Ceramic Fuel Cells Ltd, on the defect chemistry and chemical diffusion in electrode materials was also completed.

**Quality Assurance**

ANSTO's Engineering Division was audited by the Standards Australia's Quality Assurance Services in June for continued compliance with the International Quality Standard AS/NZS/ISO 9001. This was a re-certification audit which is carried out every three years. No non-conformances were recorded.
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The National Association of Testing Authorities (NATA), Australia, conducted an audit to reassess ANSTO’s mechanical testing capabilities. The audit covered procedures and testing methods used in the laboratory. ANSTO maintained its accreditation and was accredited to carry out additional tests.

Twenty four commercial customers used ANSTO’s Quality Control Section for their testing needs, following recommendation by Standards Australia and the National Association of Testing Authorities, Australia. Type testing of cross-linked polyethylene and polypropylene pipes and fittings were done to AS2492, draft standard DR 94094 and draft standard DR 94095. The tests help commercial customers to obtain Standards Australia marking for their products. They also help customers who wish to sell quality overseas products in Australia.

Commercial leasing of ANSTO property

The Business and Technology Park at Lucas Heights remains an integral part of ANSTO’s technology transfer strategy. Office and laboratory space is leased to industrial tenants who benefit from access to ANSTO’s unique capabilities. The Park has shown steady growth with the expansion of leased areas.

ANSTO became a member of the Australian Association of Science and Technology Parks. Membership of the Association, which aims to encourage commercialisation of research and development, has enabled ANSTO to work with other parks to promote increased interaction with industry.

Safety services

Radiation standards

ANSTO maintains Australian standards for radioactivity measurement according to its delegation under the National Measurements Act 1960. The focus is on supporting the nuclear medicine community, particularly through calibration programs, to ensure the accuracy and legal traceability of activity measurements made by ANSTO’s Radiopharmaceuticals Division.

ANSTO is collaborating with the National Physical Laboratory (NPL) in the United Kingdom to develop a new approach to radioactivity measurement known as Digital Coincidence Counting (DCC). This method, which uses the latest in high-speed electronics and computer technology, promises to be more reliable, flexible and cost-effective than existing methods and will extend the range of standards which can be produced. ANSTO staff visited NPL, where a prototype system was established. The application of this technology to other areas is also being investigated.

The Secondary Standard Dosimetry Laboratory (SSDL) facility will be re-established by early 1998. The facility will provide a full calibration service for dosimetry equipment used by hospitals’ radiotherapy departments. This will allow measurements made on this equipment to be traced to the Australian primary standard for dose from exposure to ionising radioactive substances. The Laboratory will meet criteria set by the Organisation Internationale de Metrology Legale D 21 for cobalt-60 quality radiation. The ANSTO SSDL will participate in annual rounds of the IAEA dosimetry intercomparisons.

ANSTO began negotiating with the Australian Radiation Laboratory to collaborate on standard calibration.

Radiation protection training

ANSTO’s radiation protection training staff continued to provide courses across Australia. During the year, 39 radiation protection courses were run, 21 of which were provided to external organisations in industry and government. A total of 346 personnel from 115 organisations were trained in the basics of radiation protection. A summary of these courses is provided below.

Radiation protection consultancies

ANSTO’s safety staff provided radiological advice and health physics coverage for a number of external organisations. Remediation of a South Australian disposal site containing rocket parts made with a thorium alloy was completed in October as part of a larger scale project for Australian Defence Industries. The site was completely excavated and all material containing radioactive material was isolated and stored in appropriate containers. A radiological investigation of a military disposal area in Victoria was completed.
in July, with the area intensively surveyed and no radioactive material detected. In April work was completed for the Defence Science and Technology Organisation on the investigation, classification, drumming and transport of material in a radioactive store due for decommissioning. All material was identified and placed in containers in compliance with the Commonwealth Code of Practice for the Safe Transport of Radioactive Substances, 1990. Radiological advice was also provided, on a consultancy basis, for organisations such as the Office of the Supervising Scientist.

Ongoing radiation protection consultancies include a major radiological review for a large Australian mining company and radiological advice on a remediation project in Malaysia. The radiological review for the mining company involves a detailed analysis of all the implications of processing ore containing trace amounts of uranium, including the effects on occupational and public exposure.

**Occupational health and safety**

ANSTO staff undertook consultancies relating to noise, dust, solvents and gases for eight clients. One five-day occupational hygiene course and two two-day confined space training courses were run during the year for both ANSTO and external participants from organisations around Australia. Five three-day courses on safety in laboratories were run in centres across Australia.

**Risk and reliability services**

Industry made increased use of ANSTO's risk and reliability services. Consultancies were provided for a preliminary hazard analysis update for Sydney Water's Cronulla Sewage Treatment Plant; a hazard and operability study, fire safety, and construction safety study and compilation of a Safety Management System for Croda Coatings Pty Ltd; a computer hazard and operability study for a proposed Supervisory Control and Data Acquisition system for Sydney Water's Bondi Sewage Treatment Plant; and a review, in association with Pacific Power, of fire, explosion and flood protection of critical pumping equipment at North Head Sewage Treatment Plant.

A comparative risk study was conducted for Rhône-Poulenc on transport of gangue residue (containing radioactive thorium and uranium) for a rare earths extraction venture in Western Australia. This study was presented both as a report and at a series of meetings with interested members of the public and government. The assessment evaluated the comparative risks for transport by road and rail.
Specialist engineers from ANSTO provided Goninan, an Australian-based company, with a reliability and maintainability assessment in support of designs for light-rail passenger vehicles for the Kowloon Canton Rail Corporation’s Tuen Mun project. The risk and reliability analysis services provided by ANSTO reduced the company’s commercial exposure to reliability penalty clauses in contracts for these projects.

An assessment of risk reduction options for chlorine storage and handling was carried out for Sydney Water at West Hornsby Sewage Treatment Plant.

Radiopharmaceuticals

ANSTO continued to support the health care industry and medical research by developing radiopharmaceuticals and radionuclides, principally for diagnosing and treating cancer and diagnosing neurological disease. The radionuclides are produced in the research reactor HIFAR or at the National Medical Cyclotron.

Research concentrated on the development of chemical and biological compounds which, when labelled with suitable radionuclides, can be used for imaging or therapeutically irradiating selected disease sites. Other work included improving methods of producing radionuclides that can be used as radiolabels for ANSTO-developed and imported pharmaceuticals.

The development of new radiopharmaceuticals includes radiolabelling, pre-clinical pharmacological evaluation, radiation dose determination, development of quality control procedures and development of methods for routine manufacture. This includes design and manufacture of automated production equipment for in-cell use. New ANSTO-developed radiopharmaceuticals are evaluated in clinical trials in collaboration with specialist physicians. These are conducted in accordance with the requirements of the Therapeutic Goods Administration of the Commonwealth Department of Health and Family Services.

ANSTO continued to support university research through the Australian Institute of Nuclear Science and Engineering. Two students supported by AINSE Post Graduate Fellowships worked on radiopharmaceutical research projects and one PhD thesis was completed. Two Year-in-Industry students from the University of Technology, Sydney, worked on Radiopharmaceuticals Division projects and two staff members worked towards PhD degrees.

Eighteen refereed journal papers were published by Radiopharmaceuticals Research and Development staff and a number of papers were presented at international and Australian conferences. Staff participated in an IAEA Research Coordination Meeting on therapeutic radiopharmaceutical production and quality control and in a consultants’ meeting on molybdenum-99 production.

Molecular radiopharmaceuticals

Positron emission tomography (PET) and single photon emission computed tomography (SPECT) are advanced techniques for imaging disease sites for improved diagnosis or for monitoring the progress of a disease or its response to therapy.

ANSTO is developing new PET and SPECT radiopharmaceuticals based on organic molecules labelled with cyclotron produced radionuclides such as iodine-123 and fluorine-18. Several clinical trials for evaluation of new radiopharmaceuticals were begun or have been approved for commencement in the near future.

Research during the year included the synthesis, radiolabelling and biological evaluation of several peripheral benzodiazepine receptor ligands as potential radiopharmaceuticals for investigating neuronal and glial damage and possibly certain tumours in which these receptors are involved. Two iodine-123 labelled compounds, iodozolpidem and a commercial compound, GBLD-952, showed promise and will be investigated further. Iodine-123 labelled N-Methyl dextetimide was investigated as a means of evaluating receptor changes in the heart associated with diabetes. Work commenced on a strategic research project to develop possible SPECT radiopharmaceuticals for the diagnosis of movement disorders such as epilepsy and Parkinson’s disease.

Radionuclide development and dosimetry

There is considerable potential for the use of radiolabelled biological carrier molecules for cancer therapy, provided that suitable high specific activity radionuclides can be produced. Current research is
focussed on separating high specific activity radiolanthanides, including holmium-166, lutetium-177 and terbium-161, from their radioactive parent nuclides. The decay properties of these nuclides cover a range of therapeutic possibilities. Holmium-166 and lutetium-177 labelled peptides have potential for therapy of solid tumours.

An automated system for lanthanide separations was successfully evaluated for separation of holmium-166 from dysprosium-166. The high specific activity holmium-166 produced has been used to label biological molecules to be evaluated as possible therapeutic radiopharmaceuticals.

Work began on several projects to improve processes used at ANSTO for commercial radiopharmaceutical production.

A new ion-exchange process for separating molybdenum-99 from irradiated uranium targets to produce technetium-99m generators was demonstrated on a laboratory scale. It increased product yields by 20 per cent. Experiments on a semi-production scale were begun. A successful outcome will result in considerable cost savings.

Chromium-51 chromate, used for blood cell labelling, is currently imported by ANSTO for dispensing and resale. The possibility of in-house production was investigated and a potential production method successfully developed. Any decision to change over to in-house manufacture will be based on commercial considerations.

Work continued on the extraction of useful by-product radionuclides from targets irradiated at the National Medical Cyclotron for commercial production of nuclides such as gallium-67. The most important of these by-products is copper-64, which is being used to study genetic defects as part of a collaboration with Melbourne University. Commercially viable yields at a specific activity higher than previously published internationally are now being obtained. This work was reported at The 7th International Workshop on Targetry and Target Chemistry held in Heidelberg, Germany.

**Bioradiopharmaceuticals**

Many biological molecules, including monoclonal antibodies and peptides, have a strong affinity with specific disease sites. Research at ANSTO is directed towards developing methods to radiolabel appropriate molecules to provide new radiopharmaceuticals for diagnosis or therapy.

Whole antibodies were labelled with copper-64 using diamino hydroxyl ethylene tetra acetic acid (DAHA-EDTA) as a linking compound, and evaluated in tumour-bearing mice. The observed rapid clearance of the compound from the remainder of the body indicates its potential for PET imaging of uptake within six hours of administration. This result indicates that if DAHA-EDTA is used to radiolabel proteins such as streptavidin/avidin, the more specific tumour targeting would result in improved imaging or radioimmunotherapy. A US patent for the use of the DAHA-EDTA ligand for radiolabelling bio-molecules was granted.

**Commercial production of radiopharmaceuticals and radioisotopes**

ANSTO continued to supply radiopharmaceuticals to public and private nuclear medicine centres throughout Australia, New Zealand and Asia. Production relies on the complementary facilities of the HIFAR research reactor and the National Medical Cyclotron.

Sales of radiopharmaceuticals and radioisotopes for medical, industrial and research use rose to $12.3 million. Sales of iodine-131 and technetium-99m generators increased, while sales of other radiopharmaceutical products remained at levels close to previous years.

Export sales to markets in New Zealand, Taiwan, the Philippines, Korea and China continue to expand.

Negotiations were carried out with leading international radiopharmaceutical organisations for ANSTO to significantly increase its role as a supplier of reactor- and cyclotron-produced isotopes to the Australian and South East Asian nuclear medicine communities. Negotiations are nearing completion on a complementary Technical Cooperation Agreement.

Operating efficiency and staff safety were improved through automation of some processes in the assembly of technetium-99m generators and the dispensing of thallium-201 and gallium-67 products. An automated conveyor transfer system for the dispatch of products, commenced last July, reached
the pre-commissioning trial phase. Implementation is expected within three months.

The quality of the installation of a new cell face for the Iodine 131 production cell was ensured by dimensional and non-destructive testing. Certificates of construction were issued for various types of radioactive packages.

Quality Control laboratories were refurbished and the equipment updated. This upgrade has enabled staff to report results faster and with greater accuracy.

ANSTO has contracted to manufacture specialised therapeutic pharmaceutical products for two public hospitals, St. George Hospital and Royal North Shore Hospital. The pharmaceuticals are made to the contracting hospital’s formulation.

ANSTO’s technetium-99m generators are used in many nuclear medicine centres throughout Australia and are a principal product of the radiopharmaceuticals production section. A project to improve the design of the technetium-99m generator commenced.

An inspection of ANSTO’s radiopharmaceuticals production facilities for quality assurance accreditation under the Australian/New Zealand ISO 9000 series is due in the last quarter of 1997. Procedures and work instructions have been written in accordance with requirements. ANSTO already meets Therapeutic Goods Administration requirements as a licensed pharmaceutical manufacturer. Accreditation to the Australian/New Zealand ISO 9000 quality standard series will enhance this compliance.

**Therapeutic Radiopharmaceuticals**

ANSTO has been licensed by Dow Chemical USA to manufacture and sell in Australia and in certain South East Asian countries the therapeutic radiopharmaceutical Samarium-153 EDTMP, known as Quadramet™. It is administered to reduce the pain associated with bone metastases, which can arise from a variety of primary cancers.

Due to limitations associated with the HIFAR reactor, the Australian product is slightly different from the overseas version. To study the effects, if any, of this difference, a clinical trial of 19 patients was conducted between September 1995 and August 1996. The results showed there was no difference between the bioequivalence of the Australian and overseas products. Since this time small quantities of the drug have been supplied to various Australian hospitals under the Special Access Scheme of the Therapeutic Goods Administration (TGA).

In October 1996, a request to market Quadramet™ generally in Australia was lodged with the TGA, with the results of the clinical trial forming an important part of the submission. Approval of the submission and subsequent significant sales of Quadramet™ are expected in the second half of 1997.

Dr Suzanne Smith conducting radiolabelling experiments at levels of high activity using manipulators attached to hot cells.
ANSTO’s high quality grounds and gardens, often remarked upon by visitors, contribute substantially to the standard of work conditions enjoyed by staff. Col Tarrant supervises both in-house and contract staff in maintaining ANSTO’s surrounds.

**Drivers: ANSTO and government**

**OBJECTIVE**

To provide best practice corporate support, safety management, information and human resource management for ANSTO’s eight hundred staff.
OUTCOMES

- Consistent and effective budget and financial management services were delivered to all business units and executive management, the budget being restructured to reflect core businesses and output categories.

- The financial information delivery platform was enhanced by the development of an information retrieval system.

- More comprehensive labour cost information was produced by upgrading the existing timesheet recording system.

- Savings in warehouse operations were achieved through increased reliance on just-in-time purchasing.

- The staffing profile was adjusted to enhance resourcing of science activities and provide more cost effective and flexible support services.

- New staff courses tailored to the organisation's strategic goals and structure were introduced. Topics included project management, teamwork, leadership, and setting objectives.

- A set of management competency standards was developed and used to assess the competencies of 36 senior managers.

- A relatively stable industrial relations environment was maintained. Lost time due to industrial action was limited to an issue directly related to the negotiation of a new Enterprise Agreement.

- A new Enterprise Agreement covering all staff was successfully negotiated with representative employee organisations on behalf of staff.

- New International Atomic Energy Agency recommendations for the physical protection of the HIFAR research reactor, nuclear materials and facilities were implemented.

- A government review of the Australian Protective Service (APS) service identified physical protection at ANSTO as core work. This means that the APS will continue to carry out this task.

- ANSTO enhanced its ability to meet national, international and organisational objectives through continued development of its management systems, using the International Standards Organisation's ISO 9000 series as a benchmark.

- The organisation's quality and safety culture was further improved by using quality tools to enhance the efficiency and effectiveness of ANSTO's processes and products.

- ANSTO's information management division was reorganised to better meet its commitments to provide information services and computer resources to the Organisation.

ACTIVITIES AND OUTPUTS

Finance and supply services

Strategic advice and support services were provided across a wide range of finance and supply functions including treasury, taxation, management and financial reporting, financial systems administration, accounting services, major and minor procurement, and warehouse management.

The project costing module within the Prophecy financial information management system was reviewed. As a consequence, the ANSTO timesheet recording system was completely redesigned and comprehensive changes made to its time allocation structure for capturing and reporting salary and superannuation costs against projects. The new timesheet recording and cost allocation system was implemented on schedule and without sacrifice to system stability. Extensive training was provided to users.

Development of a Financial Information Retrieval System was completed. This is part of an ongoing project to enhance the delivery of financial information to users. The system is a valuable decision support tool with sufficient flexibility to align reporting with core business and business plan activities.

As part of a continuous improvement program, policies, systems and procedures were reviewed to ensure integrity and fitness for their intended purposes. New policy and procedures for the administration of foreign currency transactions were developed and approved by the Board Audit Committee. Other procedures were amended to take account of specific requirements, technology
development and operational initiatives that add value to the business.

To justify the published value of its real property, ANSTO obtains an independent valuation on its land, buildings, electrical and site services at three-yearly intervals. The Australian Valuation Office undertook a new valuation during the year, based on existing use. This valuation forms the basis for the published values of land, buildings and site services disclosed in the Financial Statements appended to this report.

Under the auspices of the Government’s Major National Research Facility Program, ANSTO manages the Australian Synchrotron Research Program. The Prophecy Financial Information Management System is used to manage its financial transactions. A new reporting entity separate from ANSTO was established for the purpose.

Courses on accrual accounting principles and ANSTO processes were conducted during the year for administrative staff to ensure that their development matched the Organisation’s needs.

Warehouse operations were revised and rationalised. The principle of just-in-time purchasing was implemented. As a result, the number of inventory-controlled items kept in the warehouse was reduced from around 2500 to 500. Stock held is now limited to items of a hazardous or bulky nature, accountable printed forms and other essential items that cannot be obtained on a just-in-time basis.

**Budget**

ANSTO is a budget-dependent organisation, relying on Government appropriation to carry out its activities. The principles associated with ANSTO’s budget allocation are identified in a framework Triennium Funding Agreement between the Minister for Finance, the Minister for Science and Technology and ANSTO. The 1996-97 financial year was the final year of the third triennium funding period. Government savings measures impacting upon the ANSTO budget for 1996-97 totalled $6.35 million and comprised efficiency dividends/savings measures of $1.35 million and a one-off reduction of $5 million.

A parliamentary appropriation of $63.651 million was received in 1996-97 (1995-96, $65.602 million) and included an amount of $3.86 million borrowed forward from the 1997-98 appropriation to fund the cost of transporting a quantity of HIFAR spent fuel elements to Scotland and their reprocessing there. After taking this borrowing into account, the 1996-97 appropriation amount was 8.8% less than the amount appropriated the previous year.

**Revenue**

Total operating revenue from independent sources totalled $27.254m (1995-96, $27.558m). External earning generated by research and services totalled $23.42m (1995-96 $23.71m), which represented 25.77% of total income and exceeded the external revenue target of 20% of total annual income set by Government.

External earnings included $12.283m from the sale of radiopharmaceuticals, $2.043m from silicon irradiation services and $1.936m from grants.

**Figure 1 External Income**

**Expenditure**

A significant development in the 1996-97 budget process was the introduction of Topic Driven Research Projects, which are undertaken by multi-disciplinary project teams of staff from a number of Divisions.
Expenditure was in line with budget provisions against core business activities and special expenditure categories. Figure 2 provides an expenditure profile based on core business activities.

Direct costs associated with the establishment and operation of the new strategic research projects accounted for 2.45% of total expenditure.

Salaries and payments in the nature of salaries is the single largest component of running cost, representing 53.56% of total operating expenses.

Some $14,478 million was spent during the year to maintain and upgrade the capital stock of the organisation. A breakdown of this expenditure is given in the table below.

### Building development and facilities improvement

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<tr>
<th>Description</th>
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<td>Building maintenance, refurbishment and development</td>
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<tr>
<td>Radiopharmaceutical production facilities</td>
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<td>Waste Management Facility</td>
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<td>Electrical system upgrade</td>
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<td>Water reticulation and effluent systems upgrade</td>
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<td>Cyclotron PET facility</td>
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<td><strong>Sub total</strong></td>
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<th>Research facility and equipment for research and scientific services</th>
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**Total**

<table>
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<tbody>
<tr>
<td>14.478</td>
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**Figure 2 Expenditure Profile**

- Organisational Development & Support 15.4%
- Radiopharmaceutical Production 8.3%
- International Strategic Relevance of Nuclear Science & Technology 7.3%
- Core Nuclear Facilities Operation & Development 34.0%
- Application of Nuclear Science & Technology to Understanding of Natural Processes 7.2%
- Treatment of Radioactive Substances 10.1%
- Competitiveness & Ecological Sustainability of Industry 18.7%

**Insurance**

Insurance is a central element of ANSTO's risk management policy. The organisation has policies covering risk in relation to professional indemnity, public and product liability, and industrial special risk for a property used substantially for commercial purposes. In addition, directors' and officers' insurance was acquired. This policy extends to all Board members and officers of ANSTO.

This insurance strategy is based on the Commonwealth's insurance principles, which require claims or losses derived from insurable risk associated with commercial activities to be covered by commercial insurance, with other claims and losses subject to consideration for acceptance by the Commonwealth on a case by case basis.
Other significant expenditure during the year was for:

- supply of fresh fuel stock for the HIFAR reactor: $2.098m
- transport and reprocessing of HIFAR spent fuel: $1.803m
- progression of operations against an approved waste management action plan: $1.579m

Quality assurance

All Divisions continued to develop and implement their management systems to meet quality system requirements. One unit, HIFAR, achieved third party certification of its management system and a second began working towards it. Engineering has had this certification for three years. Other units have been working to gain third party accreditation for the test and/or inspection services they provide. Third party certification of management systems and accreditation of processes help ANSTO meet its statutory and customer requirements for processes undertaken and products provided.

Staff received further training in quality management and its objectives through the ANSTO Quality Management course, an internal quality system audit course and other short courses. Awareness of the relationship between quality of products, processes and improved safety and customer and stakeholder satisfaction is increasing.

Use of internal quality system audits increased. These system audits are used to verify the current status of processes and to identify areas for process, product and safety improvement.

Site services

A broad range of site services were maintained to support research and other business activities. ANSTO's cleaning service was outsourced. Management of the cafeteria and the adjacent Lucas Heights Motel continued to be outsourced, with a new contract executed which delivers a financial return to ANSTO.

Significant savings were achieved as a result of the review and rationalisation of in-house transport services. A small in-house transport function remains. This service was also considered for outsourcing, but retained because of its importance to the marketing and distribution of radiopharmaceuticals. The staff transport service to and from the Lucas Heights site is now provided exclusively on a contract basis.

ANSTO's gardens continued to be maintained by in-house staff. All other grounds maintenance, including lawn mowing services, are provided under competitive contracts. Recycling and daily waste removal services continued to be provided in-house, after taking account of the specialised nature of some wastes.

Human resource management

An internal review and redirection of research activities, combined with a need to achieve more cost effective operational support resulted in changes to ANSTO's staffing profile. This process involved interviews and placement of some staff in alternative jobs within the Organisation. A number of staff elected to leave in accordance with voluntary redundancy arrangements.

Advice and support was provided to staff and management on payroll, rehabilitation, compensation, performance appraisals and the associated appeals process, overseas travel, recruitment advertising, immigration matters and ANSTO's Common Law and other legal issues.

Staff carried out a detailed analysis of the payroll service to confirm its integrity and effectiveness. Its integrity was also confirmed through an independent audit.

Staff were provided with advice in relation to the Privacy Act, the Safety Rehabilitation and Compensation Act 1988, Equal Employment Opportunity policy and the Career Advancement System.

Work experience for young Australians

A work experience program placed 80 applicants during the year. In addition, 20 undergraduate students received 10 weeks of industrial training during the university summer vacation.

ANSTO continued its support of the Australian Quality Council's E Teams program. Two teams of senior secondary students from neighbouring
schools were sponsored to work on actual business projects. The first, from Heathcote High School, examined the conducted tours of the site offered by the organisation, while the second, from Lucas Heights Community School, considered how ANSTO could better provide information relevant to school students. Both groups produced highly practical suggestions which are being implemented.

Human resource development

A set of ANSTO management competencies was developed. Thirty-six senior managers participated in a Development Centre to assess them against these competencies as the basis for a continuing program of development.

The process for continuing development and application of ANSTO's competencies was included in the 1997 Enterprise Agreement. Work commenced on defining generic competencies within the three broad categories of science and engineering, craft and technical and administrative services. A focus group approach is being used to allow staff to use experience from their career streams to help identify and develop competency requirements and standards for ANSTO.

Senior managerial staff attended a course to examine and improve practices in managing change, teamwork and team planning processes.

Administrative staff attended a two-day residential course on team work and leadership practices. The course will assist staff in implementing inter-divisional work arrangements.

Following a decision to set a common date for all staff assessments and objective setting, to coincide with the organisation's business planning cycle,

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<td>Health and safety courses</td>
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<td>Management and general administration courses</td>
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<td>196</td>
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<td>Quality assurance courses</td>
<td>12</td>
<td>68</td>
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<tr>
<td>Science courses, seminars and conferences</td>
<td>130</td>
<td>150</td>
<td>26</td>
<td>445</td>
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</table>

Scholarships valued at $323,000 were paid to universities for undergraduate, postgraduate and year-in-industry student training.

Total number of days spent by staff on training or attending seminars, conferences or symposia 2,730

Average number of courses attended by males 1.9

Average number of courses attended by females 2.2

Aboriginal and Torres Strait Islander staff participating in training programs 2
workshops were run for ANSTO supervisors and managers on setting objectives and relating them to business plans.

A program of self-paced learning using a CD-ROM nuclear series from the United Kingdom was introduced. This proved beneficial to both engineering and nuclear technology staff.

**Employee and industrial relations**

The introduction of the Workplace Relations Act 1996, in December was supported by an information program to ensure that all staff knew of the legislation and understood its impact on employment arrangements at ANSTO.

There were extensive negotiations between management and representative unions to develop and agree on a new Enterprise Agreement. The previous Agreement expired on 29 October 1996. Negotiations were protracted and at one stage unions called a one-day strike to support their claims. Despite that action, agreement on the final package was reached without recourse to the Industrial Relations Commission. ANSTO’s Enterprise Agreement was the first public sector agreement to be certified under the new legislation. The 30-month agreement provides for moderate salary increases in return for greater productivity through simplification of employment arrangements and the introduction of human resources based reforms.

The industrial relations environment remained stable despite the climate of change created by the new Workplace Relations Act. This stability resulted from the strong consultative framework that exists between management, staff and unions. Monitoring of current trends in employment and industrial relations has helped ANSTO maintain contemporary industrial relations standards.

**Business development**

Work began on revising ANSTO’s manual on doing business with external agencies, Commercialisation of Research. It will be reissued as Business Guidelines. A system for project management was initiated and trialed for its use in research projects. Its implementation will be integrated with the Business Guidelines.

Business collaboration staff helped Divisions to develop contracts for 25 projects.

The promotion of ANSTO to industry continued with the development of a corporate brochure promoting ANSTO’s capabilities.

**Upgrading of electrical supply**

The program of review and improvement of the site electrical distribution system continued with the replacement or refurbishment of building switchboards and the completion of the low voltage switchboard works in the site substations. Since the four-year upgrade of major capital works began in 1993, some 600 site switchboards and associated cables have been assessed and replaced or modified. This should ensure that the site is reliably served by its local distribution system for the next 10 to 20 years. Power factor correction equipment has also been installed. As well as correcting the power factor, this equipment allows monitoring and storage of many of the electrical operating characteristics of the supply system and will allow more accurate and effective planning of additions and changes to the system.

**General site maintenance**

A number of laboratories were refurbished to clean room standard. Ventilation systems and fume cupboards were also upgraded.

A water reticulation system upgrade was completed. Most buildings and laboratories now have separate supplies of potable and non-potable water. Fire safety equipment continued to be upgraded. This involved installing additional hydrants and hose reels and replacing some of the older fire alarm systems.

ANSTO’s Works Unit was restructured with an increased focus on outsourcing most of the maintenance and building infrastructure development work. Key in-house-staff were retained to ensure quality of work and safety are not compromised and specialist skills not lost.

A data base on lifting equipment was maintained. Lifting gear continued to be inspected to ensure compliance with ANSTO’s safety requirements.

Pressure testing and temperature calibrating capabilities were upgraded. All on site pressure vessels that were due for inspection were inspected.
and relevant certificates issued. The site pressure vessels were classified in accordance with the requirements of AS3901:1993. The information gained was utilised in ANSTO’s submission to Comcare to obtain licence to operate the pressure vessels on site.

**Information management**

ANSTO’s information management services were re-organised to reflect the changing needs of the organisation, and the rapidly evolving technological framework in which those services are delivered. Four main teams were formed: Information Delivery (encompassing Library and Records), Applications, Operational and Technical Support, and Scientific and Strategic Computing. The Division is advised by a cross Divisional Information Management and Technology Consultative Group, which reviews current work, refines and endorses proposed standards for personal computer purchases, and discusses proposals for changes in operating regimes and the deployment of new technology. It also recommends on change management of computing facilities across the organisation.

Library activities using the skills of library, records and computer specialists include organising and evaluating information sources, building specialised databases, such as INIS, creating and customising Web front-ends such as that in the Online Library Catalogue (Voyager) or the Structured Information Manager (SIM), and advising and training users on how to efficiently access, search and retrieve information to meet their needs.

Further refinements were made to the ANSTO/CSIRO Voyager library system with the aim of improving user response times, and refining the user interface. Desktop access is now available to all staff via Windows or Web interfaces. Work continued on converting the existing Library card catalogue to an electronic form. This should be complete early in the next financial year. It will improve desktop access to a significant portion of the library collection and allow further efficiencies in the management of Library resources.

A new service was launched to provide staff with Internet access to new publications via a commercial vendor. Titles requested by staff can be automatically e-mailed to the Library, and purchase can take place electronically.

Desktop access to bibliographic information, abstracts, keywords and table of contents information for scientific papers in over 7000 research journals via SIM was successfully implemented. SIM is an information retrieval system accessible to ANSTO scientists via the CSIRO Libraries network.

An ANSTO Library World Wide Web Home Page was launched. For the public it provides information about the Library, access to the ANSTO/CSIRO Online Catalogue and links to useful Internet resources. For staff, it provides additional desktop access to subscribed databases, electronic journals, forms and quick reference guides. Staff can also use the system to request a new records file.

Draft documentation for an updated Information security policy was prepared to reflect the ‘whole of government’ view that security consists of four elements: people, information, resources and property. The documents will form one section of ANSTO’s upgraded Security Handbook.

ANSTO completed a review of the current resources used to provide and support information technology within the organisation. The review, initiated by the Office of Government Information Technology, covered areas of mainframe, mid-range and desktop computing, but specifically excluded application development. It was estimated that the support costs for ANSTO’s desktop computing systems were about $130 a month per desktop personal computer and about $70 per person per month for Unix computing. A system was implemented to more accurately capture information technology support costs, which will enable the organisation to determine the cost effectiveness of possible outsourcing in the future.

An extensive upgrade of the site computer network connections was carried out. In addition, ANSTO, in partnership with CSIRO, upgraded its Australian Academic Research Network (AARNet) connection from a 56Kbps to a 2Mbps link, resulting in faster and more reliable services. Use of the 2Mbps link had reached 40% of its capacity by June. The whole AARNet service contract was renegotiated with Optus by AARNet to provide increased capacity at reduced cost from the beginning of the new
The Fujitsu vector computer was replaced with a Silicon Graphics multi-processor machine, which has proved a remarkably efficient and cost effective central computing facility for ANSTO. A scientific and strategic computing team assisted the various scientific topic teams in planning their work and provided scientific computing and visualisation in support of research and topic projects. The group also developed a strong collaborative arrangement with Fujitsu Laboratories in Japan, resulting in a fully funded project from Fujitsu on the continuing development of visualisation techniques.

A voice-mail system to support up to 500 users was implemented, and users across the site are being added in manageable increments. A video-conferencing facility was installed and has provided significant savings on the cost of interviewing overseas applicants for ANSTO positions. It has also been used for scientific collaboration with overseas counterparts.

Hardware replacements for the existing Novell Corporate Server system were evaluated and delivered, resulting in more disk storage space for clients, improved speed and performance, and greater system resilience and disaster recovery. New delivery mechanisms were put in place to provide networked access to CD-ROM products from the desktop. Response times to Help Desk requests were reduced and a pilot scheme to improve service delivery by using a desktop management system was completed.

The use of e-mail by ANSTO staff has continued to increase over the past year, with over one gigabyte per month now being sent. More importantly, the use of e-mail as a means of group and site-wide communication within ANSTO is becoming commonplace, with the creation of a number of special mailing lists, including one for all ANSTO staff members, and separate divisional and affinity grouping lists.

The first successful download of electronic data for employee contributions to ComSuper was undertaken during the year. They have continued on a pay-by-pay basis. An Employer Superannuation Interim Costing Capture computer system was implemented from the first pay for the financial year. Historical costing information is now held in the Financial Information Management System (FIMS), ready for attribution to specific projects or Divisional cost centres when staff timesheets are processed.

Procedures for approving and recording ANSTO's scientific publications through the ProCite database were revised. ProCite is a database management program which organises references and formats bibliographies automatically. A ProCite Web interface, accessible via the ANSTO Home Page, was designed to facilitate data capture from across the site.

Security

A new physical protection system for the HIFAR research reactor and nuclear material storage facilities was implemented to meet International Atomic Energy Agency guidelines. Additional electronic access control systems were introduced to further enhance security on the remainder of the site.

The role of the Australian Protective Service (APS) in guarding ANSTO was included in a government review which focused on the APS's role, functions, structure and funding. The review identified ANSTO's guarding requirements as core work, with the result that the Service will continue to provide protective security guarding and take responsibility for the counter terrorism first response role at the Lucas Heights Science and Technology Centre.

Communications

ANSTO completed a comprehensive community attitudes survey, which sought the specific ANSTO issues important to the public together with the public's attitudes towards the organisation. Conducted with the assistance of stakeholders from the Sutherland Shire Council, Sutherland Shire Environment Centre and a representative appointed by the community, it surveyed more than 900 people in Sutherland Shire, Bankstown-Liverpool, and Wollongong and Sydney, and a small control group in Melbourne. The survey's results, which were made public, are being used to refine elements of ANSTO's communications strategy and will provide the benchmark for future attitudes and opinions measurements.
ANSTO and representatives of its community have continued to meet every two months with an independent facilitator who is managing the process. As well as providing a forum at which general information exchanges could take place, talks on specific items, such as synroc, were arranged. Work continued on the development of a Community Right to Know code, a document that would set out the ways in which ANSTO and the community would deal with each other in regard to information about the Organisation’s activities.

A speakers program built around providing ANSTO staff to talk to community groups about the Organisation’s activities was relaunched in January. Almost 50 bookings were held at the end of the financial year, with a strong word of mouth factor driving inquiries. The majority of talks were to Sutherland Shire groups. The speakers program is being expanded to address the information needs of school students.

The range of information on ANSTO’s Internet Home Page continued to be expanded. On average, 2200 inquiries a week were made of the page, with heaviest demand usually following media publicity about the organisation. Development has begun of ANSTO’s first fully electronic publication, its educational resource A Nuclear Source, which will be available on the Home Page. It will replace the previously paper-based version and will be available in the first half of the next financial year. Information from ANSTO’s corporate brochure is forming the basis of a continuously expanding electronic library of the organisation’s capabilities on the Home Page.

Interaction with the news media continued on an almost daily basis. A number of journalists from national and local media outlets made familiarisation visits to ANSTO. Advertorials covering both general ANSTO activities and a series of ‘What I Do at ANSTO’ profiles of staff were published in local newspapers.

Guided tours of ANSTO remained popular, with some 5000 visitors to the site. It was noticeable that more commercial tour operators are adding ANSTO to their schedules. Discussions are continuing with local tourism authorities about promoting linkages with other popular visitor destinations in the Sutherland Shire.

In taking information about its activities to a broader audience, ANSTO participated in exhibits ranging from the community to the national level. The latter included events such as the Australian Science Festival and the Conference of the Australian Science Teachers’ Association, CONASTA.

There was a continuing high level of demand for ANSTO’s graphic design services, with work done ranging from the ANSTO Strategic Plan, a corporate brochure and the weekly staff newsletter, to posters, displays and conference papers.

Photography services were also in high demand, with some 300 assignments completed in the year. The work of ANSTO’s photographer, Tim Tapsell, was recognised by his peers by his being accepted into the Australian Institute of Medical and Biological Illustration.

Land management issues

Following a NSW Government endorsed mediation process between the Waste Service NSW and the Sutherland Shire Council, the Waste Service is proposing to extend operations at the Lucas Heights Waste Management Centre (WMC) while providing funding and work in kind to develop a major sporting and recreational complex at the nearby closed Lucas Heights No.1 disposal site.

The current operation at the WMC and the proposed operations extension are mainly located on land within the 1.6 km radius buffer zone around the HIFAR research reactor. It is leased by the Waste Service from ANSTO. The proposal includes overtopping filled waste disposal areas, establishing waste processing facilities and green waste composting areas, and an electricity generation plant that will utilise landfill gas collected from the waste fill areas.

The Waste Service also proposes to rehabilitate the waste fill areas to a form that will allow the ANSTO lease area, as well as its own land, to be made available in due course for possible recreational activities not catered for at the proposed Lucas Heights No.1 sporting complex. Any recreational activity proposed for the ANSTO lease area will be
subject to approval by ANSTO and must meet safety
criteria that take State emergency response
requirements into account. The Waste Service is
preparing an Environmental Impact Statement and
associated environmental management plan as part
of the requirements of the NSW environmental
assessment process. This process and
documentation is expected to also satisfy the
requirements of the Commonwealth Environment
Protection (Impact of Proposals) Act 1974, which would
be applicable to that part of the proposal on ANSTO
land.

A revised lease agreement is being negotiated
between ANSTO and the Waste Service in
anticipation of development consent for the
proposal being granted by the NSW authorities.

**Patents**

ANSTO had 120 patents and patent applications at
the close of the financial year.

**Ecologically sustainable development**

The goals, core objectives and guiding principles of
the national strategy on Ecologically Sustainable
Development were recognised and implemented in
ANSTO’s activities during the year.

The Australian Protective Service (APS) plays a
major role in ensuring the security of the ANSTO
site. In a recent review of the APS it was decided
that guarding ANSTO was core work for the APS
and that it should continue to provide this service.
Performance Indicator 1

**ANSTO Contracts 1995-96 and 1996-97 ($ value over $1,000)**

<table>
<thead>
<tr>
<th>Core business areas</th>
<th>No. 1996-97</th>
<th>% completed 1996-97</th>
<th>No. 1995-96</th>
<th>% completed 1995-96</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISRNS</td>
<td>62</td>
<td></td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>CNFOD</td>
<td>50</td>
<td></td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>ANST</td>
<td>100</td>
<td></td>
<td>75</td>
<td></td>
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<tr>
<td>TMRS</td>
<td>50</td>
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<td>25</td>
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<tr>
<td>CESI</td>
<td>25</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>ODS</td>
<td>100</td>
<td></td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

Source: ANSTO Government and Public Affairs Division
Performance Indicator 2  
*ANSTO allocation of resources into agreed priority areas*
1995-96 and 1996-97

Expenditure ($'000)
- 1996-97: $88,979
- 1995-96: $88,856

*Radioisotope production

Performance Indicator 4  
*ANSTO science and technology-based gross revenue*
1995-96 and 1996-97

Science- and technology-based gross revenue ($'000)
- 1996-97: $23,885
- 1995-96: $23,710

*Radioisotope production

Source: ANSTO Corporate Services Division
Performance Indicator 5  

**ANSTO publications by type 1994-95, 1995-96, 1996-97**

![Bar chart showing ANSTO publications by type from 1994-95 to 1996-97.](chart)

*Source: ANSTO Government and Public Affairs Division*

Performance Indicators 6 & 10  

**Cooperation with industry, research organisations and the university sector**

![Bar chart showing cooperation metrics from 1994-95 to 1996-97.](chart)

*Source: ANSTO Government and Public Affairs Division*
Performance Indicator 7  
**Provision of advice to Government**

- **Core business areas:**
  - ISRNS
  - CNFOD
  - ODS

- **Total person years:** 20.13
  - (1995-96: 20.63 person years)

Source: ANSTO Business Plans

Performance Indicator 8  
**Contribution to international networks and to international policy developments**

- **Core business areas:**
  - ISRNS
  - CNFOD
  - ANST
  - TMRS
  - CESI
  - ODS

- **Total person years:** 22.5
  - (1995-96: 18.75 person years)

Source: ANSTO Business Plans

Performance Indicator 9  
**Degree of usage of maintained facilities by external users 1996-97**

**Major Facilities**

- **HIFAR Research Reactor**
  - AINSE-funded projects outside the organisation utilised 383 instrument days. ANSTO research involving collaboration with university groups and training of Doctors of Philosophy (PhD) students utilised 161 instrument days. (1995-96: 337 instrument days for external users)

- **Tandem Accelerator**
  - External users accounted for 50% of operational time (1995-96 = 40%)

- **National Medical Cyclotron**
  - Production of isotopes for scientific purposes accounted for 12.5% of beam time (1995-96 = 10.8%)
  - Production of isotopes for sale accounted for 87.5% of beam time (1995-96 = 89.2%)
SITE SAFETY

SITE SAFETY ARRANGEMENTS

ANSTO is committed to ensuring a safe and healthy environment at the Lucas Heights Science and Technology Centre for employees, visitors and contractors.

OBJECTIVES

Promote best practice in health and safety and involve staff in ownership of their own health and safety.

Provide and maintain safety systems and assessment procedures.

Ensure that risks to staff and the public associated with ANSTO's operations are kept as low as is reasonably achievable.

OUTCOMES

• Implementation of the safety policy on site resulted in a safe working environment for employees, visitors and contractors.

• Safety staff ensured that ANSTO's safety systems and policies conformed to international best practice and complied with statutory requirements in occupational health and safety. A health promotion program was implemented.

• All staff working with radioactive materials had their radiation exposure monitored to ensure that radiation doses complied with internationally agreed limits for both Lucas Heights staff and the public. No member of staff was exposed to a dose greater than 15 millisieverts (mSv), compared to the internationally agreed limit of 20 mSv. Controls, monitoring and assessment ensured that off-site exposures from airborne emissions from ANSTO were less than 1% of the public dose limit.

• Effluent discharged into the Sydney Water sewer system met all limits for radioactive pollutants in accord with the Trade Waste Agreement with Sydney Water. This agreement requires compliance at the Cronulla Sewage Treatment Plant with World Health Organisation drinking water standards for radioactivity.

• The effectiveness of the ANSTO emergency management plans was demonstrated in exercises with emergency services organisations.

ACTIVITIES AND OUTPUTS

Occupational Health and Safety Policy

In compliance with requirements of the Occupational Health and Safety (Commonwealth Employment) Act 1991, the ANSTO Occupational Health and Safety Policy was published in full in the 1992/93 ANSTO Annual Report. It has not been necessary to make any changes to the policy. ANSTO continued to implement all parts of the policy, which is widely distributed throughout ANSTO as Safety Directive 1.2 'Occupational Health and Safety Policy', reissued on 27 September 1996.

The report of Comcare Australia’s audit of ANSTO’s compliance with the Occupational Health and Safety (Commonwealth Employment) Act 1991, was received in August. The report indicated that ANSTO’s performance was ‘exceptionally good’ and that ‘ANSTO has achieved a remarkable result in all areas of this planned investigation’. The report also noted that there was a high level of management commitment to improving health and safety performance at Lucas Heights and that ANSTO was one of the few organisations in NSW currently complying with the new regulation on manual handling. Only three recommendations were made. These related to more frequent workplace inspections, developing a health promotion program and rationalising quantities of hazardous materials. All were followed up.

Accidents and incidents

Staff continued to be encouraged to report all incidents and accidents so that investigations could be made and any trends identified. They included those occurring during sporting activities and while travelling to and from work.

In addition to the ANSTO internal reporting and investigation system, certain types of accident must be reported to the government agency, Comcare, under the provisions of Section 68 of the Occupational Health and Safety (Commonwealth Employment) Act.

In the past year, 23 accidents were notified and subsequently reported under this Act. Four incidents were classified as serious personal injury, 14 as
extended absences and three as dangerous occurrences, using the categories defined by Comcare. None of these accidents or incidents involved radiation. Two further notifications were made, allegedly due to unsubstantiated radiation-related incidents five and six years ago. One claim has been denied by Comcare and the other is pending but not supported by ANSTO.

Half of the incidents were related to manual handling. ANSTO is continuing to pursue strategies aimed at reducing manual handling incidents. The dangerous occurrences were a tree branch falling on a vehicle, a contractor cutting through a live cable and a runaway fork lift truck.

Of those classified as serious personal injury, the most serious was a contractor who electrocuted himself but survived. The others were a laceration in a workshop, a minor acid splash and an elderly visitor who fell boarding a tour bus.

Radiation protection

As part of the assurance of safety at work for all staff, the ANSTO Personal Dosimetry Service monitored the external radiation exposure of 754 persons working at the Lucas Heights Science and Technology Centre and at the National Medical Cyclotron, located at the Royal Prince Alfred Hospital, Sydney.

The highest effective dose for the year to any individual was 15.0 mSv, which is well below the annual dose limit of 20 mSv (averaged over 5 years).

Table 1 shows the maximum, average and collective effective doses for the past four financial years.

The effective doses reported last year included an interim correction factor. Further investigation during the year following the results of an international intercomparison of personal dosimeter measurements has required slight modification of the correction factor. This has been incorporated in the above table. The results of the intercomparison indicated that ANSTO was one of the most accurate of the 32 participating laboratories.

The radioisotope dispatch area is undergoing modification and automation in order to improve efficiency and keep doses to workers to a minimum. The period of modification has caused difficult work conditions for a few personnel and this, together with the increases in radioisotope production, has resulted in higher effective doses for them. Completion of the modifications will greatly improve working conditions and reduce doses to dispatch workers.

Table 2 shows the distribution of effective (whole body) doses for the past four financial years.

Table 1: Effective dose

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<tbody>
<tr>
<td>Max dose mSv</td>
<td>10.7</td>
<td>11.5</td>
<td>14.8</td>
<td>15.0</td>
</tr>
<tr>
<td>Ave dose mSv</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Col dose Person mSv</td>
<td>667</td>
<td>625</td>
<td>701</td>
<td>730</td>
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Table 2: Distribution of effective doses (mSv)

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<tr>
<td>≤ 2</td>
<td>689</td>
<td>684</td>
<td>671</td>
<td>657</td>
</tr>
<tr>
<td>&gt; 2 to 5</td>
<td>77</td>
<td>63</td>
<td>87</td>
<td>66</td>
</tr>
<tr>
<td>&gt; 5 to 10</td>
<td>24</td>
<td>19</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>&gt; 10 to 15</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 15 to 20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>0</td>
<td>0</td>
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</table>
Seventy-two per cent of workers monitored received less than 1 mSv and no worker received more than 15 mSv. The three highest doses were received by dispatch workers in ANSTO's radioisotopes dispatch area, and 23 of the 28 workers with doses between 5 and 10 mSv are involved with radiopharmaceutical production at the Lucas Heights site or the National Medical Cyclotron. A comparison of the maximum and average effective doses for the past three years is shown in Figure 1.

The ANSTO Personal Dosimetry Service also measures shallow doses of all monitored workers. The highest shallow dose for the year to any individual was 16 mSv, which is well below the national and international annual dose limit of 500 mSv.

Doses to extremities, hands and fingers, are also monitored for those workers handling radioisotopes and likely to receive a dose to their extremities significantly different from the dose to their body. The highest extremity dose to any individual for the year was 167 mSv, considerably less than the annual dose limit of 500 mSv.

In addition to monitoring external exposures, ANSTO also monitors internal exposures, both routinely for staff who have the potential for internal exposure, and in response to incidents. Methods used include bioassay (tritium in urine) and whole body and thyroid counting. Any significant doses are added to those from external radiation and are included in the effective doses.

ANSTO is committed to maintaining a safe working environment and keeping radiation doses As Low As Reasonably Achievable (ALARA). A new policy for performing ALARA assessments was produced during the year and agreed to by the Nuclear Safety Bureau.

Environmental discharges

Airborne emissions

In the course of their normal operations, some facilities produce small quantities of gaseous emissions. Emissions are minimised by treatment and filtration prior to discharge and all are constantly monitored. The effect on the surrounding environment is too small to directly monitor, so an atmospheric dispersal model is used to estimate the doses to the surrounding region and the public.

The results of discharge monitoring and dose assessments showed that radiation doses to staff and the public due to the discharges were well within annual limits recommended by the National Health & Medical Research Council and less than the dose constraints adopted by ANSTO.

The maximum annual exposure for 1996/97 resulting from these discharges was 0.015 mSv on the Lucas Heights Science and Technology Centre site and 0.009 mSv on the boundary of the 1.6 km buffer zone.

These doses are well below the average dose of 2.4 mSv per year received from natural background radiation, and off-site exposure is less than the dose of 0.01 mSv that would be received during a return flight from Sydney to Melbourne.

The Australian Radiation Laboratory and the Safety Review Committee continued to provide independent monitoring of ANSTO's airborne discharges. This role will be transferred to the new Australian Radiation Protection and Nuclear Safety Agency, planned to be in place by July 1998. In May, the Nuclear Safety Bureau, with assistance from the Australian Radiation Laboratory and the Office of the Supervising Scientist, conducted an audit of all discharge monitoring from HIFAR. This confirmed that the very low doses were an accurate record of public exposures.

Revised discharge authorisations, more accurately reflecting the operational patterns at ANSTO, were agreed upon with the Nuclear Safety Bureau. These relate the authorisation directly to the off-site dose.

Liquid effluent discharges

Effluent discharged from ANSTO into the Sydney Water sewer met all limits for radioactive discharges in accordance with the Trade Waste Agreement with Sydney Water. These limits ensure compliance at the Cronulla Sewage Treatment Plant with World Health Organisation drinking water standards for radioactivity.

For non-radioactive materials, all discharges were in compliance with the Trade Waste Agreement.
Environmental survey

ANSTO regularly surveys levels of radioactivity within and external to the Lucas Heights Science and Technology Centre, using samples of soil, creek water, stormwater, seawater, vegetation and air. Results are published annually and are publicly available in local libraries. These results confirm compliance by ANSTO with all relevant regulatory limits.

Safety assessment

All facilities, experiments and processes on the Lucas Heights Science and Technology Centre with potential hazards are assessed and approved by safety committees. In addition to this internal approval system, there are external independent government approval and review bodies established to report on ANSTO's activities. These are the independent Nuclear Safety Bureau for all issues to do with nuclear plant, and the Safety Review Committee for all other issues. The Reactors Safety Committee also provides advice to ANSTO's Executive Director.

Safety Assessment Committee

For all potentially hazardous activities not directly involving the HIFAR reactor, approval is given by the Safety Assessment Committee, which consists of representatives from a range of ANSTO Divisions and an external independent expert. During the year, it reviewed some 180 submissions. All submissions are examined by assessors before being presented to the Committee and are renewable annually. Conditions on the proposed operations are followed up to ensure they are implemented.

During the year, a revised assessment procedure was introduced. It strengthens the risk assessment process and emphasises the need to minimise and segregate radioactive waste.

Reactors Safety Committee

The terms of reference of the Reactors Safety Committee (RSC) are:

- to provide advice as requested by the Executive Director on matters relevant to the safety of nuclear plant operated by ANSTO
- to review and advise the Executive Director on proposals for experiments, changes in operations, or modifications to nuclear plant operated by ANSTO which involve significant safety issues
- periodically to review the operation of ANSTO's nuclear plant for evidence of an appropriate safety culture, adequate safety management, and compliance with Operating Authorisations and other procedures.
- The committee has a Chairman external to ANSTO. It met four times during the reporting period.
- The RSC's objectives are to ensure the existence of an adequate safety system that is based on appropriate standards. With these aims in view, the Committee paid particular attention to reviewing:
  - reports on abnormal occurrences, their safety significance and corrective actions taken
  - safety audit procedures for the decommissioning of the Moata reactor
  - site liquid and airborne emissions and offsite doses
  - the Nuclear Safety Bureau's regular reports on the safety of ANSTO's nuclear plant
  - reports on major safety activities including the probabilistic safety assessment of HIFAR, updating of the HIFAR Safety Document, and safety culture studies.

Emergency response

Emergency arrangements

A 24-hour emergency response capability is provided at the Lucas Heights Science and Technology Centre. Additionally, emergency arrangements are maintained and exercised in conjunction with State agencies.

Emergency planning at the Lucas Heights Science and Technology Centre is conducted under the provisions of the NSW State Emergency and Rescue Management Act 1989. This Act requires that a
range of plans, generally known as DISPLANs, are in place for potential emergencies. The purpose of these plans is to allow for emergencies to be controlled at the lowest appropriate level. The arrangements make provision for assistance to be provided should the incident escalate. This assistance is a staged process and provides for escalation of emergency control from local to district to State level. For the arrangements to be effective, all involved agencies are required to have in place appropriate internal instructions and/or standing operating procedures and to make resources available when required. Plans that have a direct bearing on activities at the Lucas Heights Science and Technology Centre are explained below.

Response to accidents, incidents or emergencies are covered by two plans. The Lucas Heights Science and Technology Centre Emergency Plan describes the on-site emergency arrangements for situations which can be handled by ANSTO personnel. The ANSTO Emergency Plan (DISPLAN) provides for the on-site emergency arrangements which require assistance and control from the NSW combat agencies. ANSTO personnel provide full technical support to this plan.

Accidents, incidents or emergencies with off-site consequences are covered by escalating arrangements consisting of the Sutherland Shire Local Disaster Plan (DISPLAN), the St George - Sutherland District Disaster Plan (DISPLAN) and the NSW State Disaster Plan (DISPLAN).

The ANSTO Local Liaison Working Party (LLWP) is responsible for preparing the ANSTO Emergency Plan (DISPLAN). ANSTO’s Safety Division and the LLWP prepare the Lucas Heights Science and Technology Centre Emergency Plan. Membership of the LLWP consists of representatives of ANSTO, NSW emergency services organisations and local government. The Nuclear Safety Bureau is an observer. The LLWP met on four occasions during the year with a very high level of participation by the NSW emergency services organisations. Revised site emergency response plans were endorsed on 27 November and published as a single document: ‘Lucas Heights Science & Technology Centre - Emergency Planning Arrangements’. This was distributed to emergency services organisations, local government, and associated organisations, including libraries and local federal and State members of parliament.

During the year numerous new Procedure Documents were produced for ANSTO personnel involved in the emergency plans. The emergency response plan for the National Medical Cyclotron was endorsed and circulated. A ‘Safety and Emergency Procedures Manual’ was developed to final draft stage.

**Emergency exercises**

Emergency exercises are held to test the effectiveness of all, or selected aspects, of the emergency arrangements.

All actions resulting from the site emergency exercise in June 1996 were implemented. Ongoing training, radiation awareness training and site familiarisation is being provided for the NSW Fire Brigade.

An emergency tabletop exercise, ‘Exercise Bushy’ was held in February. A tabletop exercise is one where a series of scenarios are presented to the players. A facilitator then extracts from each player how they or their organisation would respond to each stage of the scenario. This scenario was a bush fire that threatened the site, igniting materials around Building 23A and eventually causing a fire, inside the building, which released a toxic plume.

About half of those attending, including a community representative, came from external organisations. It is believed this is the first time a tabletop exercise of this type has been conducted at ANSTO.

The objectives were to test components of the arrangements in the Lucas Heights Science and Technology Centre Emergency Plan and the ANSTO Emergency Plan (DISPLAN) together with the supporting Standing Operating Procedures. The objectives were achieved and resulted in minor improvements to emergency arrangements.

At the National Medical Cyclotron a building evacuation exercise was conducted and a tabletop exercise is being planned.
Atmospheric dispersion

High quality meteorological data have been collected at Lucas Heights since the 1960s. An additional three meteorological stations were installed in 1993 to study the influence of complex terrain on atmospheric transport and dispersion patterns. Data collected between 1975 and 1996 were summarised as a climatological report.

ANSTO staff began work on a major study to investigate and validate atmospheric dispersion models used for emergency response planning. This involves comparing a number of internationally recognised models with atmospheric tracer data collected in the Lucas Heights area. Tracer studies were undertaken at intervals during the year to study a range of meteorological conditions.

Other safety services

A full range of health physics, occupational health and safety, medical, nuclear safety and risk and reliability services were provided to ANSTO facilities, including HIFAR and the National Medical Cyclotron. Of particular importance were the development of safety cases for many of the major facilities at ANSTO and the NMC.

ANSTO conducts extensive, year-round sampling of its environment to ensure it maintains its record of operating well within international, national and State standards for emissions from its site. Emmy Hoffman is pictured taking a sample from a creek near ANSTO.
Tracerco Australasia is a partnership between ANSTO and ICI Australia Operations Pty Ltd. It is a commercial operation whose business is applying radioisotope technology to solve problems in industrial process plants.

The company is based at the Lucas Heights Science and Technology Centre in premises rented from ANSTO. It carries out projects on clients’ work sites throughout Australia, New Zealand and South-east Asia.

Tracerco Australasia benefits from technical input from ANSTO and commercial input from ICI Australia. The company’s continuous exposure to a wide range of industries allows Tracerco to function as an information channel through which problems of general importance to Australian industry may be fed back to the parent organisations for research.

Tracerco Australasia continued to perform strongly in 1996-97 and the original sales budget of $1.05 million was revised upwards to $1.15 million. The outstanding feature of the year’s performance was the rapid growth of business in Asia, with projects carried out in South Korea, Singapore, Thailand and Malaysia. Asian business accounted for 60% of the total sales income and prospects for continuing business are excellent.

On mainland Australia, Western Australia was by far the most important market, accounting for 23% of total sales, followed by New South Wales (11.5%) and Victoria (5%). Combined sales in Queensland and South Australia represented only 0.5% of the total and promotional initiatives are now being directed at industries in these States to redress the balance.

As in previous years, Tracerco Australasia’s activities have been dominated by the oil industry. Sales to oil refining, oil/gas production and downstream chemicals accounted respectively, for 60%, 15% and 22% of revenue. Though sales to mineral processing industries accounted for only 13% of the total income, Tracerco Australasia identified excellent opportunities to provide services and instrumentation to that sector. These are expected to come to fruition in 1998.

The company continued to lend its support to the activities of the International Atomic Energy Agency.
AINSE is a consortium of universities in partnership with ANSTO. By the end of 1996 all but two minor Australian universities had joined the consortium. The University of Auckland is also a member, bringing the total number of member universities to 36. The Institute was established by the Commonwealth Government in 1958 to conduct research into nuclear energy and to provide training in the nuclear field. AINSE's mission today is to advance research, education and training in nuclear science and engineering and their applications within Australia by being, in particular, the key link between universities, ANSTO and major nuclear science and engineering and associated facilities.

AINSE's objectives for the next five years were unanimously approved on 6 December 1996 by the governing Council, which consists of a representative of each member University, the Executive Director of ANSTO and the directors of seven ANSTO scientific and technical divisions. These objectives are:

1. to ensure users in member organisations of AINSE have access to major nuclear science and engineering and associated facilities for research purposes
2. to facilitate graduate and undergraduate education and training experience utilising major nuclear science and technology facilities
3. to encourage collaboration and co-operation between member organisations of AINSE in areas primarily related to nuclear science and engineering and their applications and
4. to sustain and support the development of major nuclear science and technology facilities in Australia for shared use by member organisations of AINSE.

AINSE is a non-profit making institute incorporated under the NSW Associations Incorporation Act 1984. All sources of funds coming to AINSE are used in supporting university research. University projects are mainly supported through grants to cover costs associated with operating and developing ANSTO's facilities.

AINSE operates on a calendar year basis. This report covers 1 January to 31 December 1996.

In 1996, income of $2,595,949 was made up of $1,002,300 from ANSTO, $527,050 from university subscriptions, $806,717 from external grants, $216,868 from interest on investments and $43,014, mainly from conference registrations.

AINSE acts as a peak body on behalf of its member organisations in applying for and administering major research infrastructure grants. In this respect, 1996 was a very successful year, with Australian Research Council (ARC) grants of $300,000 and $225,000 awarded in support of Quaternary Science utilising the ANTARES Accelerator Mass Spectrometry facility and the National Neutron Scattering facility, respectively. In addition, ARC grants of $150,000 for Secondary Ion Mass Spectrometry and $120,000 for Plasma Fusion research were also awarded. With respect to the latter, AINSE is part of the consortium which has been awarded $8.7 million for the National Plasma Fusion Research Facility based on the H1-Heliac stellerator device at the Australian National University. AINSE is responsible for facilitating access to this facility by researchers from member universities.

Applications for ARC funding in 1997 have again been successful, with grants of $300,000 for the ANTARES AMS facility (through the University of Western Australia), $60,000 for the SIMS facility, and $250,000 for the Heliac facility at the ANU.

A total of 153 university projects were supported in 1996 under the AINSE grant scheme with a further 54 AMS and Heliac projects funded from the ARC grants, bringing the total to 207. In addition, 20 postgraduate students received AINSE supplements and grants for access to ANSTO's facilities. ANSTO subsidises these awards by providing additional time on its facilities at no cost to AINSE. The students also provide valuable support for ANSTO's research.

Two national conferences and two workshops were organised by AINSE in 1996. AINSE-supported researchers spent about 2000 instrument days using ANSTO's facilities and there were approximately 800 person-days spent attending the AINSE conferences and workshops.

The 1996 AINSE Gold Medal for Excellence in Research supported by AINSE was awarded to
Professor Andrew Gleadow and the La Trobe University Fission Track Analysis Group. Dr Jarrod Martin of the University of New South Wales, was awarded the Student Gold Medal for his work as a postgraduate student. A pilot series of undergraduate experiments on ANSTO's facilities were held this year for the first time.

The President of AINSE for 1995 and 1996 was Professor Bob Breakspere from Central Queensland University. The Vice President was Professor Trevor Ophel from the Australian National University. The Executive Officer is Dr Roger B Gammon.

Member organisations of AINSE as at 31 December 1996:

- ANSTO
- University of Adelaide
- University of Auckland
- Australian National University
- University of Ballarat
- University of Canberra
- Central Queensland University
- Charles Sturt University
- Curtin University of Technology
- Deakin University
- Edith Cowan University
- Flinders University of South Australia
- Griffith University
- James Cook University of North Queensland
- La Trobe University
- Macquarie University
- University of Melbourne
- Monash University
- Murdoch University
- University of New England
- University of New South Wales
- University of Newcastle
- Northern Territory University
- University of Queensland
- Queensland University of Technology
- Royal Melbourne Institute of Technology
- Southern Cross University
- University of South Australia
- University of Southern Queensland
- Swinburne University of Technology
- University of Sydney
- University of Tasmania
- University of Technology, Sydney
- Victoria University of Technology
- University of Western Australia
- University of Western Sydney
- University of Wollongong.
In the opinion of the Members of the Board of the Australian Nuclear Science and Technology Organisation, the attached financial statements for the year ended 30 June 1997 represent fairly the information required by the Minister for Finance's Guidelines for Financial Statements of Commonwealth Authorities.

Signed in accordance with a resolution of the Members of the Board.

Max Richards
1/9/1997
Sydney

Helen M Garnett
1/9/1997
Sydney
FINANCIAL STATEMENTS

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION

OPERATING STATEMENT
FOR THE YEAR ENDED 30TH JUNE 1997

<table>
<thead>
<tr>
<th>Notes</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$'000</td>
<td>$'000</td>
</tr>
</tbody>
</table>

**NET COST OF SERVICES**

**Operating Expenses (before abnormal items)**

International Strategic Relevance Of Nuclear Science | 6,456 | 4,734 |
Core Facilities Operation and Development | 29,377 | 28,607 |
Application Of Nuclear Science and Technology to Natural Processes | 6,316 | 7,003 |
Treatment and Management of Radioactive Substances | 8,970 | 7,367 |
Competitiveness and Ecological Sustainability Of Industry | 16,598 | 18,628 |
Organisational Development and Support | 13,760 | 15,597 |
Radiopharmaceuticals Operations | 6 | 7,502 | 6,920 |

**Total Operating Expenses (before abnormal items)** | 4 | 88,979 | 88,856 |

**Operating Revenues from Independent Sources**

International Strategic Relevance Of Nuclear Science | 942 | 1,009 |
Core Facilities Operation and Development | 3,632 | 3,782 |
Application Of Nuclear Science and Technology to Natural Processes | 965 | 1,121 |
Treatment and Management of Radioactive Substances | 912 | 826 |
Competitiveness and Ecological Sustainability Of Industry | 3,651 | 3,494 |
Organisational Development and Support | 4,842 | 5,266 |
Radiopharmaceuticals Operations | 6 | 12,310 | 12,060 |

**Total Operating Revenues from Independent Sources** | 5 | 27,254 | 27,558 |

**Net Cost of Services (before abnormal items)** | 4 | 61,725 | 61,298 |

**Net Cost of Services** | 4 | 61,725 | 66,615 |

**REVENUES FROM GOVERNMENT**

Parliamentary appropriations received

Operating | 7 | 47,431 | 49,777 |
Capital | 7 | 16,220 | 15,825 |

**Total Revenues from Government** | 63,651 | 65,602 |

**Surplus/(Deficit)** | 1,926 | (1,013) |

**EQUITY INTEREST**

Accumulated Surpluses at beginning of reporting period | 10 | 87,857 | 86,872 |
Amounts Transferred from Reserves | 10 | 2,098 | 1,998 |

**Total Available For Appropriation** | 91,881 | 87,857 |

Accumulated Surpluses at end of reporting period | 91,881 | 87,857 |

The accompanying notes form an integral part of these financial statements.
### Statement of Assets and Liabilities

**AS AT 30 JUNE 1997**

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEBT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leases</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Debt</strong></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>PROVISIONS AND PAYABLES</strong></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td>15,710</td>
<td>15,377</td>
</tr>
<tr>
<td>Suppliers</td>
<td>3,224</td>
<td>1,523</td>
</tr>
<tr>
<td>Other payables</td>
<td>3,414</td>
<td>4,240</td>
</tr>
<tr>
<td>Other provisions</td>
<td>6,059</td>
<td>8,763</td>
</tr>
<tr>
<td><strong>Total Provisions and Payables</strong></td>
<td>28,407</td>
<td>29,903</td>
</tr>
<tr>
<td><strong>Total Liabilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28,407</td>
<td>29,907</td>
</tr>
<tr>
<td><strong>EQUITY</strong></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Reserves</td>
<td>89,942</td>
<td>59,552</td>
</tr>
<tr>
<td>Accumulated Surpluses</td>
<td>91,881</td>
<td>87,857</td>
</tr>
<tr>
<td><strong>Total Equity</strong></td>
<td>181,823</td>
<td>147,409</td>
</tr>
<tr>
<td><strong>Total Liabilities and Equity</strong></td>
<td>210,230</td>
<td>177,316</td>
</tr>
<tr>
<td><strong>FINANCIAL ASSETS</strong></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>13,237</td>
<td>15,519</td>
</tr>
<tr>
<td>Receivables</td>
<td>3,408</td>
<td>3,428</td>
</tr>
<tr>
<td><strong>Total Financial Assets</strong></td>
<td>16,645</td>
<td>18,947</td>
</tr>
<tr>
<td><strong>NON-FINANCIAL ASSETS</strong></td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Land and buildings</td>
<td>124,254</td>
<td>98,538</td>
</tr>
<tr>
<td>Infrastructure, plant and equipment</td>
<td>12</td>
<td>59,467</td>
</tr>
<tr>
<td>Inventories</td>
<td>13</td>
<td>4,908</td>
</tr>
<tr>
<td>Intangibles</td>
<td>14</td>
<td>144</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>579</td>
</tr>
<tr>
<td><strong>Total Non-Financial Assets</strong></td>
<td>193,585</td>
<td>158,369</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>210,230</td>
<td>177,316</td>
</tr>
</tbody>
</table>

The accompanying notes form part of these financial statements.
The cash balances at 30 June 1997 and 1996 as shown in the Statement of Cash Flows are reconciled to the related items in the Statement Of Assets and Liabilities.

The accompanying notes form an integral part of these financial statements.
# SCHEDULE OF COMMITMENTS

AS AT 30 JUNE 1997

<table>
<thead>
<tr>
<th>Note</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$000</td>
<td>$000</td>
</tr>
<tr>
<td><strong>BY TYPE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CAPITAL COMMITMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property, plant and equipment</td>
<td>1,591</td>
<td>4,788</td>
</tr>
<tr>
<td>Waste treatment and disposal project</td>
<td>9</td>
<td>5,365</td>
</tr>
<tr>
<td><strong>Total capital commitments</strong></td>
<td>6,956</td>
<td>4,788</td>
</tr>
<tr>
<td><strong>OTHER COMMITMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other commitments</td>
<td>2,404</td>
<td>4,502</td>
</tr>
<tr>
<td><strong>Total other commitments</strong></td>
<td>2,404</td>
<td>4,502</td>
</tr>
<tr>
<td><strong>Total commitments payable</strong></td>
<td>9,360</td>
<td>9,290</td>
</tr>
<tr>
<td>Commitments receivable</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Net commitments</strong></td>
<td>9,360</td>
<td>9,290</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$000</td>
<td>$000</td>
</tr>
<tr>
<td><strong>BY MATURITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One year or less</td>
<td>4,542</td>
<td>6,746</td>
</tr>
<tr>
<td>From one to two years</td>
<td>2,330</td>
<td>2,544</td>
</tr>
<tr>
<td>From two to five years</td>
<td>2,488</td>
<td>-</td>
</tr>
<tr>
<td><strong>Net commitments</strong></td>
<td>9,360</td>
<td>9,290</td>
</tr>
</tbody>
</table>

The accompanying notes form an integral part of these financial statements.
SCHEDULE OF CONTINGENCIES
AS AT 30 JUNE 1997

<table>
<thead>
<tr>
<th>Notes</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$'000</td>
<td>$'000</td>
</tr>
<tr>
<td><strong>CONTINGENT LOSSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposal of spent fuel (a)</td>
<td>90,000</td>
<td>90,000</td>
</tr>
<tr>
<td>Other (b)</td>
<td>100</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total contingent losses</strong></td>
<td><strong>90,100</strong></td>
<td><strong>90,000</strong></td>
</tr>
<tr>
<td><strong>CONTINGENT GAINS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total contingent gains</strong></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Net contingencies</strong></td>
<td><strong>90,100</strong></td>
<td><strong>90,000</strong></td>
</tr>
</tbody>
</table>

(a) ANSTO has an inventory of 1630 spent HIFAR fuel elements at its Lucas Heights site. ANSTO has advised Government that the options for the ultimate disposition of HIFAR spent fuel elements are:
- return of all fuel to the United States or the United Kingdom for reprocessing,
- the processing of the spent fuel domestically, or
- some combination of these options.

Having taken advice on its obligations under the ANSTO Act 1987, the Board recognises that a decision on a preferred option is a matter for Government policy. The cost of this task has been estimated at up to $90 million, dependent on the selected disposal option. ANSTO is economically dependent on the Government to meet the cost for this task (see also Note 1). No provision by ANSTO for the cost involved has been made pending the Government’s decision on a preferred disposal option.

To provide interim storage relief, the Government has appropriated to ANSTO an additional $13.05 million to fund overseas shipment of spent fuel during 1997/98 and 1998/99.

(b) As at 30 June 1997, there are three Common Law claims against the Organisation. Two of these claims have been filed in the Dust Diseases Tribunal and the remaining one in the District Court.

The accompanying notes form an integral part of these financial statements.
<table>
<thead>
<tr>
<th>Note</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Economic Dependency</td>
</tr>
<tr>
<td>2</td>
<td>Summary of Significant Accounting Policies</td>
</tr>
<tr>
<td>3</td>
<td>Segment Reporting</td>
</tr>
<tr>
<td>4</td>
<td>Operating Expenses – including Abnormal Items</td>
</tr>
<tr>
<td>5</td>
<td>Operating Revenues from Independent Sources</td>
</tr>
<tr>
<td>6</td>
<td>Radiopharmaceuticals Operations</td>
</tr>
<tr>
<td>7</td>
<td>Parliamentary Appropriations</td>
</tr>
<tr>
<td>8</td>
<td>Debt</td>
</tr>
<tr>
<td>9</td>
<td>Provisions and Payables</td>
</tr>
<tr>
<td>10</td>
<td>Equity</td>
</tr>
<tr>
<td>11</td>
<td>Financial Assets</td>
</tr>
<tr>
<td>12</td>
<td>Property, Plant and Equipment</td>
</tr>
<tr>
<td>13</td>
<td>Inventories</td>
</tr>
<tr>
<td>14</td>
<td>Intangible Assets</td>
</tr>
<tr>
<td>15</td>
<td>Other Non-Financial Assets</td>
</tr>
<tr>
<td>16</td>
<td>Cash Flow Reconciliation</td>
</tr>
<tr>
<td>17</td>
<td>Investments</td>
</tr>
<tr>
<td>18</td>
<td>Remuneration of Directors/Members of the Board</td>
</tr>
<tr>
<td>19</td>
<td>Remuneration of Executives</td>
</tr>
<tr>
<td>20</td>
<td>Insurance</td>
</tr>
<tr>
<td>21</td>
<td>Remuneration of Auditors</td>
</tr>
<tr>
<td>22</td>
<td>Related Party Disclosures</td>
</tr>
<tr>
<td>23</td>
<td>Trust Money</td>
</tr>
</tbody>
</table>
NOTES TO AND FORMING PART OF
THE FINANCIAL STATEMENTS
FOR THE YEAR ENDED 30TH JUNE 1997

1 ECONOMIC DEPENDENCY
ANSTO is dependent on appropriations from Parliament to carry out its activities.
(See also Note 20).

2 SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES
The financial statements are a general purpose financial report. They have been
drawn up:

i. having regard to the provisions of the Australian Nuclear Science and Technology

ii. in accordance with Guidelines for Financial Statements of Commonwealth
Authorities issued by the Minister for Finance, which require compliance with
Statements of Accounting Concepts, Australian Accounting Standards, Accounting
Guidance Releases and other mandatory professional reporting requirements
(Consensus Views of the Urgent Issues Group).

Basis of accounting
The financial statements have been prepared on an accrual basis and are in
accordance with the historical cost convention, except for certain assets which, as
noted, are at valuation. Except where stated, no allowance is made for the effect of
changing prices on the results or the financial position.

The principal accounting policies adopted in the preparation of these financial
statements are:

(a) Cash
For the purposes of the Statement of Cash Flows, cash includes a short term deposit
held with a bank.

(b) Bad and doubtful debts
A provision is made for any doubtful debts based on a review of all outstanding
accounts at year end. Bad debts are written off during the period in which they are
identified.

(c) Inventories
Uranium and Cobalt-60 inventories of enriched natural and depleted uranium are
valued on the basis of net realisable value.

Stocks of reactor fuel, heavy water and stores are valued at average purchase price.

Work in progress is valued at cost, which includes both direct costs and an allocation
of overhead expenses.

(d) Property, plant and equipment
Acquisition
Items of property, plant and equipment are recorded at cost and depreciated as
outlined below. Items of plant and equipment with a cost of less than $3,000 are
expended in the year of acquisition.

The cost of assets constructed by the entity includes the cost of materials, direct
labour and an appropriate proportion of fixed and variable overheads.
Revaluations
In accordance with the Guidelines for Financial Statements of Commonwealth Authorities issued by the Minister for Finance, land and buildings are required to be revalued at 3 yearly intervals. During 1996-97 an independent valuation of ANSTO land, buildings, and electrical and site services was conducted as at 30 June 1997, by Mr John Starr (registered valuer no. 2388) of the Australian Valuation Office. The basis of valuation is the depreciated replacement value based on existing use.

In accordance with AAS10, all increments and decrements relating to the one class of assets have been taken to the Asset Revaluation Reserve account.

Depreciation and Amortisation
Items of property, plant and equipment, including buildings, but excluding freehold land, are depreciated over their estimated useful lives to ANSTO ranging from 3 to 30 years. The straight line method is used.

The High Flux Australian Reactor (HIFAR) and the containment building are depreciated on the basis of an assumed life to the year 2000. This is subject to review and the useful life may be extended.

(e) Investments
Investments are brought to account at the lower of cost or valuation.

(f) Patents
Due to the uncertain commercial value of patents, and because benefits to more than one accounting period cannot be assured, the costs associated with the development and registration of patents are expended in the year in which they are incurred, unless recoverability is assured beyond any reasonable doubt. At 30 June 1997 there were 116 patents (128 at 30 June 1996) registered to ANSTO and no costs were recognised as an asset.

(g) Employee entitlements
The provisions for employee entitlements encompass annual leave and long service leave. ANSTO has a present obligation to pay both entitlements resulting from employee services provided up to 30 June 1997.

General leave
The Organisation's Enterprise Agreement provides under the heading General Leave for an employee entitlement which combines sick leave, carer's leave and leave for other prescribed purposes. No provision has been made for general leave as all such leave is non-vesting and the average general leave taken by employees is less than the annual entitlement.

Annual leave
The provision for annual leave reflects the value of total annual leave entitlements of all employees at 30 June 1997 and is recognised at its nominal value.

Long service leave
The provision for long service leave is recognised and measured at the present value of estimated future cash outflows to be made by ANSTO in respect of employees at balance date. In determining the present value of the liability, attrition rates and pay increases through promotion and inflation have been taken into account.

(h) Revenues recognition
Operating revenues from independent sources
Operating revenue from independent sources comprises revenues earned from the provision of products or services to entities outside ANSTO. Revenue is recognised when the goods are provided or when the fee in respect of the services provided is receivable.
Parliamentary appropriations
Parliamentary appropriations are recognised in the year in which they are drawn down.

Revenue received in advance
Revenue received in advance is initially brought to account as "other liabilities" and subsequently recognised as revenue when earned.

(i) Superannuation
The Australian Nuclear Science and Technology Organisation contributes to the Commonwealth Superannuation (CSS) and the Public Sector (PSS) superannuation schemes which provide retirement, death and disability benefits to employees. Contributions to the schemes are at rates calculated to cover existing and emerging obligations. Current contribution rates are 23.9% of salary (CSS) and 8.1% of salary (PSS). An additional 3% is contributed for employer productivity benefits. For those staff who do not contribute to superannuation, ANSTO contributes 6% of salary to the Australian Government Employees Superannuation Trust fund.

Contributions during the financial year are detailed at Note 4.

(j) Foreign currency
Transactions denominated in a foreign currency are converted at a rate of exchange prevailing at the date of the transaction. At balance date, amounts receivable and payable in foreign currency are translated at the exchange rate prevailing at that date and any exchange differences are brought to account in the Operating Statement.

(k) Income tax
Pursuant to Section 30 (1) of the ANSTO Act 1987, ANSTO is not subject to income tax.

(l) Intangible assets
Where recognised, intangible assets are reported at the lower of cost or recoverable amount. Accumulated amortisation is disclosed as a deduction from each class of assets separately identified.

(m) Assets received free of charge
The acquisition of property, plant and equipment free of charge or for a nominal amount is recognised initially at fair value.

(n) Comparatives
Where necessary, comparative information has been reclassified to achieve consistency in disclosure with current financial year amounts and other disclosures.

(o) Rounding
Amounts are rounded to the nearest one thousand dollars except in relation to:
- remuneration of Directors
- remuneration of Executive Officers
- remuneration of auditors
3 SEGMENT REPORTING
ANSTO operates in a single industry within Australia, namely in the nuclear scientific research industry.

4 OPERATING EXPENSES – Including Abnormal Items

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee expenses:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>36,890</td>
<td>36,534</td>
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<tr>
<td>Superannuation</td>
<td>5,477</td>
<td>6,286</td>
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<tr>
<td>Redundancy</td>
<td>1,160</td>
<td>97</td>
<td></td>
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<tr>
<td>Annual leave provision</td>
<td>3,135</td>
<td>3,146</td>
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<td></td>
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<tr>
<td>Long service leave provision</td>
<td>996</td>
<td>1,051</td>
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<tr>
<td>Total employee expenses</td>
<td>47,658</td>
<td>47,114</td>
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<td></td>
</tr>
<tr>
<td>Supplier expenses:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>General expenses</td>
<td>8,996</td>
<td>10,261</td>
<td></td>
<td></td>
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<tr>
<td>Stores</td>
<td>6,507</td>
<td>7,255</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance and external services</td>
<td>7,766</td>
<td>8,407</td>
<td></td>
<td></td>
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<tr>
<td>Power and water</td>
<td>1,932</td>
<td>1,944</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactor supplies</td>
<td>965</td>
<td>780</td>
<td></td>
<td></td>
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<tr>
<td>Variable production costs</td>
<td>2,662</td>
<td>2,194</td>
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<tr>
<td>Operating leases</td>
<td>115</td>
<td>17</td>
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<tr>
<td>Total suppliers expenses</td>
<td>28,943</td>
<td>30,858</td>
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<tr>
<td>Depreciation and amortisation:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation of property, plant and equipment</td>
<td>11,980</td>
<td>10,559</td>
<td></td>
<td></td>
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<tr>
<td>Amortisation of leased assets and licences</td>
<td>57</td>
<td>13</td>
<td></td>
<td></td>
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<tr>
<td>Total expense:</td>
<td>12,037</td>
<td>10,572</td>
<td></td>
<td></td>
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<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Provision for doubtful debts</td>
<td>30</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss on sale of plant and equipment</td>
<td>104</td>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write-off plant and equipment-stocktake</td>
<td>76</td>
<td>53</td>
<td></td>
<td></td>
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<tr>
<td>Write-off intellectual property</td>
<td>40</td>
<td>40</td>
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<td></td>
</tr>
<tr>
<td>Contributions to collaborative research projects</td>
<td>119</td>
<td>121</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear material stock revaluation</td>
<td>59</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior year adjustment</td>
<td>12</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total other expenses</td>
<td>341</td>
<td>312</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total expenses before abnormals</td>
<td>88,979</td>
<td>88,856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal expenses:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision for waste treatment and disposal costs</td>
<td>2,000</td>
<td>2,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision for transport and reprocessing of HIFAR spent fuel elements</td>
<td>2,200</td>
<td>2,200</td>
<td></td>
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<tr>
<td>HIFAR shutdown costs</td>
<td>853</td>
<td>853</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repairs to Building 54 cell door</td>
<td>264</td>
<td>264</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total abnormal expenses:</td>
<td>5,317</td>
<td>5,317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>88,979</td>
<td>94,173</td>
<td></td>
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</table>
5 OPERATING REVENUES FROM INDEPENDENT SOURCES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Sales of goods and services:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radioisotope sales</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
</tr>
<tr>
<td>Services and contract research</td>
<td>12,283</td>
<td>12,019</td>
<td></td>
<td></td>
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<tr>
<td>Silicon irradiation</td>
<td>4,149</td>
<td>4,357</td>
<td></td>
<td></td>
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<tr>
<td>CSIRO site support</td>
<td>2,043</td>
<td>2,359</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training courses</td>
<td></td>
<td>270</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>Land management</td>
<td>2,010</td>
<td>1,870</td>
<td></td>
<td></td>
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<tr>
<td>Synchrotron project</td>
<td>334</td>
<td>397</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information technology services</td>
<td></td>
<td>156</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AINSE interactions</td>
<td>1,211</td>
<td>716</td>
<td></td>
<td></td>
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<tr>
<td><strong>Total sales of goods and services:</strong></td>
<td>23,497</td>
<td>23,314</td>
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<td></td>
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</tbody>
</table>

Grants
Interest

Net gains from sale of assets:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final proceeds from disposal of Fox Laboratories Ltd</td>
<td></td>
<td>581</td>
</tr>
<tr>
<td>Profit on disposal of plant and equipment</td>
<td>355</td>
<td>368</td>
</tr>
<tr>
<td><strong>Total net gains</strong></td>
<td></td>
<td>355</td>
</tr>
<tr>
<td><strong>949</strong></td>
<td></td>
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</table>

Other revenues:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-speculative foreign exchange gain</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Transfers from waste treatment and disposal provision</td>
<td></td>
<td>133</td>
</tr>
<tr>
<td>Nuclear material stock revaluation</td>
<td>229</td>
<td></td>
</tr>
<tr>
<td>Assets received free of charge</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>25</td>
<td>52</td>
</tr>
<tr>
<td><strong>Total of other revenues</strong></td>
<td></td>
<td>462</td>
</tr>
<tr>
<td><strong>185</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>27,254</td>
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</tbody>
</table>

6 RADIOPHARMACEUTICALS OPERATIONS

Trading as Australian Radioisotopes (ARI) – Including Abnormal Items

ARI operating results, as an independent commercial unit within ANSTO, are as follows:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External sales and other revenue</td>
<td>12,310</td>
<td>12,060</td>
</tr>
<tr>
<td>Intercompany sales</td>
<td>55</td>
<td>77</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12,365</td>
<td>12,137</td>
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</table>

Expenses

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>3,312</td>
<td>3,194</td>
</tr>
<tr>
<td>Superannuation</td>
<td>393</td>
<td>407</td>
</tr>
<tr>
<td>Annual leave</td>
<td>45</td>
<td>13</td>
</tr>
<tr>
<td>Long service leave</td>
<td>93</td>
<td>85</td>
</tr>
<tr>
<td>Provision for doubtful debts</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Other operating expenses</td>
<td>3,406</td>
<td>3,029</td>
</tr>
<tr>
<td><strong>Depreciation</strong></td>
<td>223</td>
<td>162</td>
</tr>
<tr>
<td><strong>Expenses external to ANSTO (before abnormals)</strong></td>
<td>7,502</td>
<td>6,920</td>
</tr>
<tr>
<td>ANSTO support</td>
<td>4,201</td>
<td>4,603</td>
</tr>
<tr>
<td>Abnormal items</td>
<td>1,117</td>
<td></td>
</tr>
<tr>
<td><strong>Operating Surplus (Deficit)</strong></td>
<td>662</td>
<td>(503)</td>
</tr>
</tbody>
</table>
7 PARLIAMENTARY APPROPRIATIONS

<table>
<thead>
<tr>
<th>Appropriation Act No.1 Operating</th>
<th>Appropriation Act No.2 Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997 $47,431</td>
<td>1996 $16,220</td>
</tr>
<tr>
<td>1996 $49,777</td>
<td>1997 $15,825</td>
</tr>
<tr>
<td></td>
<td>1996 $63,651</td>
</tr>
<tr>
<td></td>
<td>1997 $65,602</td>
</tr>
</tbody>
</table>

8 DEBT

Finance Lease Liabilities
Funds lease liabilities recognised in the Statement of
Assets and Liabilities.

Current  1997  1996

---  -  4

9 PROVISIONS AND PAYABLES

Liabilities to Employees

<table>
<thead>
<tr>
<th>Accrued salaries and wages</th>
<th>1997 677</th>
<th>1996 408</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Leave</td>
<td>1997 4,922</td>
<td>1996 4,805</td>
</tr>
<tr>
<td>Long Service Leave</td>
<td>1997 10,111</td>
<td>1996 10,164</td>
</tr>
<tr>
<td>Aggregate employee entitlement liability</td>
<td>1997 15,710</td>
<td>1996 15,377</td>
</tr>
</tbody>
</table>

Suppliers

<table>
<thead>
<tr>
<th>Trade Creditors</th>
<th>1997 3,224</th>
<th>1996 1,523</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997 3,224</td>
<td>1996 1,523</td>
</tr>
</tbody>
</table>

Other Payables

<table>
<thead>
<tr>
<th>Revenue Received In Advance</th>
<th>1997 3,414</th>
<th>1996 4,240</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997 3,414</td>
<td>1996 4,240</td>
</tr>
</tbody>
</table>

Other Provisions

| HIFAR spent fuel elements — refer note (a) below | 1997 2,057 | 1996 3,860 |
| Waste treatment & disposal — refer note (b) below | 1997 3,990 | 1996 4,867 |
| Other | 1997 12 | 1996 36 |
| Total other provisions | 1997 6,059 | 1996 8,763 |

(a) Provision for HIFAR Spent Fuel Elements

As disclosed at Note 1, ANSTO is economically dependent on the appropriation of money by the Parliament to meet its liabilities and expenses.

In 1995 ANSTO created a provision, in an amount of $6.6 million, for the transport and reprocessing of HIFAR spent fuel elements. At 30 June 1997, $4.543 million has been expended against the provision.

(b) Provision for Waste Treatment and Disposal

In the 1995 financial year, an initial provision of $3 million was created for the management of a quantity of residual waste from past operations. This provision was increased to $5 million in 1996.

The original projected cost of $11.1 million has been confirmed and comprises $4.9 million operating expenses and $6.2 million capital expenditure. Hence no further provision has been made.

In 1996-97 $0.877 million (1995-96 $0.133 million) has been charged against the Provision.

Further expenditure of $0.702 million was capitalised.
**FINANCIAL STATEMENTS**

**10 EQUITY**

<table>
<thead>
<tr>
<th>Item</th>
<th>1997 $'000</th>
<th>1996 $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reserves</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset revaluation reserve</td>
<td>87,538</td>
<td>55,050</td>
</tr>
<tr>
<td>Fuel elements reserve</td>
<td>2,404</td>
<td>4,502</td>
</tr>
<tr>
<td><strong>Total Reserves</strong></td>
<td>89,942</td>
<td>59,552</td>
</tr>
<tr>
<td><strong>Accumulated Surpluses</strong></td>
<td>91,881</td>
<td>87,857</td>
</tr>
</tbody>
</table>

Movements are as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Asset Revaluation Reserve $'000</th>
<th>Fuel Elements Reserve $'000</th>
<th>Total Reserves $'000</th>
<th>Accumulated Results $'000</th>
<th>Total Equity $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Balance 1 July 1996</strong></td>
<td>55,050</td>
<td>4,502</td>
<td>59,552</td>
<td>87,857</td>
<td>147,409</td>
</tr>
<tr>
<td>Surplus/(Deficit)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,926</td>
<td>1,926</td>
</tr>
<tr>
<td>Net Revaluation increases/(decreases)</td>
<td>32,488</td>
<td>-</td>
<td>32,488</td>
<td>-</td>
<td>32,488</td>
</tr>
<tr>
<td>Transfers to/(from) reserves</td>
<td>-</td>
<td>(2,098)</td>
<td>(2,098)</td>
<td>2,098</td>
<td>-</td>
</tr>
<tr>
<td>Changes in accounting policies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Balance 30 June 1997</strong></td>
<td>87,538</td>
<td>2,404</td>
<td>89,942</td>
<td>91,881</td>
<td>181,823</td>
</tr>
</tbody>
</table>

**Asset Revaluation Reserve**

<table>
<thead>
<tr>
<th>Item</th>
<th>1997 $'000</th>
<th>1996 $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance as at beginning of year</td>
<td>55,050</td>
<td>55,050</td>
</tr>
<tr>
<td>Net Revaluation increases/(decreases)</td>
<td>32,488</td>
<td>-</td>
</tr>
<tr>
<td>Balance as at end of year</td>
<td>87,538</td>
<td>55,050</td>
</tr>
</tbody>
</table>

**Fuel Elements Reserve**

<table>
<thead>
<tr>
<th>Item</th>
<th>1997 $'000</th>
<th>1996 $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance as at beginning of year</td>
<td>4,502</td>
<td>6,500</td>
</tr>
<tr>
<td>Transferred to Accumulated Surpluses</td>
<td>(2,098)</td>
<td>(1,998)</td>
</tr>
<tr>
<td>Balance as at end of year</td>
<td>2,404</td>
<td>4,502</td>
</tr>
</tbody>
</table>

**Accumulated Surpluses**

<table>
<thead>
<tr>
<th>Item</th>
<th>1997 $'000</th>
<th>1996 $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accumulated Surpluses at beginning of year</td>
<td>87,857</td>
<td>86,872</td>
</tr>
<tr>
<td>Transfers from fuel elements reserve</td>
<td>2,098</td>
<td>1,998</td>
</tr>
<tr>
<td>Operating (Deficit)/Surplus</td>
<td>1,926</td>
<td>(1,013)</td>
</tr>
<tr>
<td>Accumulated Surpluses at end of year</td>
<td>91,881</td>
<td>87,857</td>
</tr>
</tbody>
</table>
### 11 FINANCIAL ASSETS

<table>
<thead>
<tr>
<th></th>
<th>1997 $'000</th>
<th>1996 $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash at bank and on hand</td>
<td>2,478</td>
<td>1,416</td>
</tr>
<tr>
<td>Fixed term investment</td>
<td>10,759</td>
<td>14,103</td>
</tr>
<tr>
<td><strong>Total Cash</strong></td>
<td>13,237</td>
<td>15,519</td>
</tr>
<tr>
<td><strong>Receivables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goods and services</td>
<td>3,438</td>
<td>3,378</td>
</tr>
<tr>
<td>Less provision for doubtful debts</td>
<td>109</td>
<td>79</td>
</tr>
<tr>
<td><strong>Total Receivables</strong></td>
<td>3,329</td>
<td>3,299</td>
</tr>
<tr>
<td>Advance held by Department of Industry Science and Tourism for overseas payments</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Other</td>
<td>19</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total Receivables</strong></td>
<td>3,408</td>
<td>3,428</td>
</tr>
</tbody>
</table>

### Age analysis of trade debtors

<table>
<thead>
<tr>
<th></th>
<th>1997 $'000</th>
<th>1996 $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td>2,169</td>
<td>1,337</td>
</tr>
<tr>
<td><strong>Overdue</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 30 days</td>
<td>831</td>
<td>1,104</td>
</tr>
<tr>
<td>30 to 60 days; and</td>
<td>225</td>
<td>300</td>
</tr>
<tr>
<td>More than 60 days</td>
<td>213</td>
<td>637</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,438</td>
<td>3,378</td>
</tr>
</tbody>
</table>
### 12 PROPERTY, PLANT AND EQUIPMENT

<table>
<thead>
<tr>
<th>Description</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land – at independent valuation (a)</td>
<td>33,223</td>
<td>33,000</td>
</tr>
<tr>
<td>Buildings – at cost</td>
<td>375</td>
<td>22,023</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>118</td>
<td>2,175</td>
</tr>
<tr>
<td>Buildings – at independent valuation (a) &amp; (b)</td>
<td>90,774</td>
<td>49,742</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>–</td>
<td>4,052</td>
</tr>
<tr>
<td>Aggregate Land and Buildings</td>
<td>91,031</td>
<td>65,538</td>
</tr>
<tr>
<td>Plant and Equipment – at cost (b)</td>
<td>58,171</td>
<td>59,638</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>27,869</td>
<td>28,226</td>
</tr>
<tr>
<td>Plant and Equipment under lease (c)</td>
<td>–</td>
<td>28</td>
</tr>
<tr>
<td>Less Accumulated amortisation</td>
<td>–</td>
<td>12</td>
</tr>
<tr>
<td>Plant and Equipment under construction</td>
<td>453</td>
<td>1,766</td>
</tr>
<tr>
<td>Aggregate Plant and Equipment</td>
<td>30,755</td>
<td>33,194</td>
</tr>
<tr>
<td>Electrical /Site Services facilities – at cost</td>
<td>–</td>
<td>11,627</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>–</td>
<td>3,750</td>
</tr>
<tr>
<td>Electrical /Site Services facilities – at independent valuation (a)</td>
<td>16,765</td>
<td>–</td>
</tr>
<tr>
<td>Aggregate Infrastructure</td>
<td>16,765</td>
<td>7,877</td>
</tr>
<tr>
<td>HIFAR – at cost</td>
<td>12,241</td>
<td>12,397</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>10,868</td>
<td>10,560</td>
</tr>
<tr>
<td>Synroc pilot plant – at cost</td>
<td>10,535</td>
<td>10,535</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>5,970</td>
<td>5,268</td>
</tr>
<tr>
<td>Silicon Rigs – at cost</td>
<td>4,565</td>
<td>5,267</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Research facility under construction</td>
<td>306</td>
<td>–</td>
</tr>
<tr>
<td>Aggregate Major/Research Facilities</td>
<td>11,947</td>
<td>11,212</td>
</tr>
<tr>
<td>Aggregate Other Infrastructure, Plant and Equipment</td>
<td>59,467</td>
<td>52,283</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>183,721</td>
<td>150,821</td>
</tr>
</tbody>
</table>

(a) An independent valuation of land, building, electrical and site services facilities was performed by Mr John Starr (registered valuer No. 2388) of the Australian Valuation Office. The 1996 comparative figures are based on valuations at 30 June 1995 with subsequent additions at cost.  
[See also Note 1(d)].

(b) Due to the recent revaluation of land, building, electrical and site services, the building component of the cyclotron facility has been revalued.
12 PROPERTY, PLANT AND EQUIPMENT (continued)
The extent of this revaluation has been included in buildings and land independent valuation (1997). The machine component of the facility has been included as plant & equipment – at cost. Consequently, the comparatives have been realigned.
The break up of cyclotron facility is as follows:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclotron facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- machine at cost</td>
<td>5,423</td>
<td>5,086</td>
</tr>
<tr>
<td>- building at cost</td>
<td>-</td>
<td>5,423</td>
</tr>
<tr>
<td>Less Accumulated depreciation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- machine at cost</td>
<td>795</td>
<td>626</td>
</tr>
<tr>
<td>- building at cost</td>
<td>-</td>
<td>795</td>
</tr>
<tr>
<td>Cyclotron facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- building at independent valuation</td>
<td>12,999</td>
<td>-</td>
</tr>
<tr>
<td>Total Cyclotron Facility</td>
<td>17,627</td>
<td>16,650</td>
</tr>
</tbody>
</table>

(c) Lease periods have matured and residual obligations paid out. Items have been transferred from Plant & Equipment Under Lease to Plant & Equipment – at cost.

Analysis of Property, Plant and Equipment, and Intangibles

Movement summary 1996-97 for all assets irrespective of valuation basis

<table>
<thead>
<tr>
<th>Item</th>
<th>Land</th>
<th>Building</th>
<th>Total Land and Building</th>
<th>Intangibles</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$'000</td>
<td>$'000</td>
<td>$'000</td>
<td>$'000</td>
<td>$'000</td>
</tr>
<tr>
<td>Gross value as at 1 July 1996</td>
<td>33,000</td>
<td>71,765</td>
<td>104,765</td>
<td>100,099</td>
<td>204,864</td>
</tr>
<tr>
<td>Additions</td>
<td>-</td>
<td>4,331</td>
<td>4,331</td>
<td>10,068</td>
<td>14,399</td>
</tr>
<tr>
<td>Revaluations</td>
<td>223</td>
<td>23,871</td>
<td>24,094</td>
<td>8,394</td>
<td>32,488</td>
</tr>
<tr>
<td>Disposals</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(7,812)</td>
<td>- (7,812)</td>
</tr>
<tr>
<td>Adjustments for revaluation</td>
<td>-</td>
<td>(9,032)</td>
<td>(9,032)</td>
<td>(4,680)</td>
<td>(13,712)</td>
</tr>
<tr>
<td>Other movements</td>
<td>-</td>
<td>214</td>
<td>214</td>
<td>(1,518)</td>
<td>(1,304)</td>
</tr>
<tr>
<td>Gross value as at 30 June 1997</td>
<td>33,223</td>
<td>91,149</td>
<td>124,372</td>
<td>104,551</td>
<td>228,923</td>
</tr>
</tbody>
</table>

Accumulated Depreciation/ Amortisation 1 July 96

| Amortisation 1 July 96             | -    | 6,227    | 6,227                   | 47,816      | 54,043 |
| Depreciation/amortisation for assets held 1 July 96 | -    | 2,666    | 2,666                   | 8,255       | 10,921 |
| Depreciation/amortisation charge for additions | -    | 106      | 106                     | 953         | 1,059 |
| Adjustments for revaluations        | -    | (9,032)  | (9,032)                 | (4,680)     | (13,712)|
| Adjustments for other movements     | -    | 151      | 151                     | (151)       | -      |
| Adjustments for disposals           | -    | -        | -                       | (7,109)     | - (7,109)|

Accumulated Depreciation/ Amortisation 30 June 97

| Net book value as at 30 June 1997   | 33,223| 91,031   | 124,254                 | 59,467      | 183,721|
| Net book value as at 1 July 1996   | 33,000| 65,538   | 98,538                  | 52,283      | 150,821|
## FINANCIAL STATEMENTS

Summary of balance of assets at valuation as at 30 June 1997

<table>
<thead>
<tr>
<th>Item</th>
<th>Land</th>
<th>Buildings</th>
<th>Total Land and Buildings</th>
<th>Other Infrastructure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>As at 30 June 1997</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
</tr>
<tr>
<td>Gross value</td>
<td>33,223</td>
<td>90,774</td>
<td>123,997</td>
<td>16,765</td>
<td>140,762</td>
</tr>
<tr>
<td>Accumulated Depreciation/Amortisation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other movements</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Net book value</strong></td>
<td>33,223</td>
<td>90,774</td>
<td>123,997</td>
<td>16,765</td>
<td>140,762</td>
</tr>
<tr>
<td>As at 30 June 1996</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
<td>$000</td>
</tr>
<tr>
<td>Gross value</td>
<td>33,000</td>
<td>49,742</td>
<td>82,742</td>
<td>-</td>
<td>82,742</td>
</tr>
<tr>
<td>Accumulated Depreciation/Amortisation</td>
<td>-</td>
<td>4,052</td>
<td>4,052</td>
<td>-</td>
<td>4,052</td>
</tr>
<tr>
<td>Other movements</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Net book value</strong></td>
<td>33,000</td>
<td>45,690</td>
<td>78,690</td>
<td>-</td>
<td>78,690</td>
</tr>
</tbody>
</table>

### 13 INVENTORIES

<table>
<thead>
<tr>
<th>Item</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Materials and stores-not held for resale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stores – at cost</td>
<td>893</td>
<td>944</td>
</tr>
<tr>
<td>Cobalt-60 sources – at net realisable value</td>
<td>596</td>
<td>573</td>
</tr>
<tr>
<td>Reactor Fuel and Heavy Water – at average purchase price</td>
<td>6,826</td>
<td>2,832</td>
</tr>
<tr>
<td>Nuclear materials – at net realisable value</td>
<td>699</td>
<td>472</td>
</tr>
<tr>
<td>Nuclear materials – at cost</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>9,034</td>
<td>4,841</td>
</tr>
</tbody>
</table>

| Work In Progress – held for sale          |       |       |
| Work In Progress – at cost                | 107   | 67    |
|                                           | 9,141 | 4,908 |

In the absence of cost figures, Cobalt 60 sources in process are valued at net realisable value.

### 14 INTANGIBLE ASSETS

<table>
<thead>
<tr>
<th>Item</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licences – at cost</td>
<td>209</td>
<td>130</td>
</tr>
<tr>
<td>Less Accumulated amortisation</td>
<td>65</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>144</td>
<td>120</td>
</tr>
</tbody>
</table>

### 15 OTHER NON-FINANCIAL ASSETS

<table>
<thead>
<tr>
<th>Item</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepayments</td>
<td>479</td>
<td>2,480</td>
</tr>
<tr>
<td>Interest Accrued</td>
<td>60</td>
<td>35</td>
</tr>
<tr>
<td>Other</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>579</td>
<td>2,520</td>
</tr>
</tbody>
</table>
16 CASH FLOW RECONCILIATION

Reconciliation of net cash flows from operating activities to Net Cost of Services

<table>
<thead>
<tr>
<th>Net Cost of Services</th>
<th>1997 $000</th>
<th>1996 $000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues from Government</td>
<td>61,725</td>
<td>66,615</td>
</tr>
<tr>
<td>Operating (Deficit)/Surplus</td>
<td>1,926</td>
<td>(1,013)</td>
</tr>
<tr>
<td>(Increase)/Decrease in Receivables</td>
<td>(48)</td>
<td>(605)</td>
</tr>
<tr>
<td>Increase/(Decrease) in Accruals</td>
<td>1,021</td>
<td>80</td>
</tr>
<tr>
<td>(Increase)/Decrease in Prepayments</td>
<td>2,000</td>
<td>(2,015)</td>
</tr>
<tr>
<td>Increase/(Decrease) in Creditors</td>
<td>983</td>
<td>(1,212)</td>
</tr>
<tr>
<td>Nuclear Materials Revaluation</td>
<td>(201)</td>
<td>7</td>
</tr>
<tr>
<td>Increase/(Decrease) in Employee Entitlements</td>
<td>65</td>
<td>538</td>
</tr>
<tr>
<td>Decrease/(Increase) in Inventories</td>
<td>(4,034)</td>
<td>738</td>
</tr>
<tr>
<td>Increase/(Decrease) in Provision for Waste treatment and disposal</td>
<td>(877)</td>
<td>1,867</td>
</tr>
<tr>
<td>Increase/(Decrease) in Provision for HIFAR spent fuel elements</td>
<td>(1,803)</td>
<td>(540)</td>
</tr>
<tr>
<td>Increase/(Decrease) in Other Provisions</td>
<td>(1)</td>
<td>23</td>
</tr>
<tr>
<td>Increase/(Decrease) in ARI Equity</td>
<td>(1)</td>
<td>1,573</td>
</tr>
<tr>
<td>Decrease/(Increase) in Assets Under Construction</td>
<td>(81)</td>
<td>301</td>
</tr>
<tr>
<td>Decrease/(Increase) in Accrued Interest</td>
<td>(24)</td>
<td>301</td>
</tr>
<tr>
<td>Foreign Exchange Gain</td>
<td>(35)</td>
<td>–</td>
</tr>
<tr>
<td>Assets Received Free of Charge</td>
<td>(172)</td>
<td>–</td>
</tr>
<tr>
<td>Prior Year Adjustments</td>
<td>–</td>
<td>(36)</td>
</tr>
<tr>
<td>Increase/(Decrease) Other Creditors</td>
<td>(826)</td>
<td>–</td>
</tr>
<tr>
<td>Depreciation/Amortisation</td>
<td>12,047</td>
<td>10,577</td>
</tr>
<tr>
<td>Gain on Sale of Assets</td>
<td>(355)</td>
<td>(368)</td>
</tr>
<tr>
<td>Loss on Sale of Assets</td>
<td>104</td>
<td>53</td>
</tr>
<tr>
<td>Trade-In on Motor Vehicles</td>
<td>802</td>
<td>–</td>
</tr>
<tr>
<td>Others</td>
<td>(610)</td>
<td>(245)</td>
</tr>
<tr>
<td><strong>Net cash provided by operating activities</strong></td>
<td><strong>9,881</strong></td>
<td><strong>10,024</strong></td>
</tr>
</tbody>
</table>
17 INVESTMENTS

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in Business Undertakings</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Tracerco Australasia
Under a partnership arrangement with ICI Australia Limited, ANSTO has a 49% interest in Tracerco Australasia. Tracerco Australasia is a commercial business concerned with the application of radioisotope technology to the solution of problems in industrial process plants. ANSTO's 49% share of the accumulated losses to 30 September 1996 is $681,325. ANSTO's investment in this venture ($580,650) has been written off. ANSTO's share of accumulated losses in excess of its investment to date, together with any liability for future losses, is assessed as not material and has not been brought to account.

18 REMUNERATION OF DIRECTORS/MEMBERS OF THE BOARD

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members' remuneration is determined by the Remuneration Tribunal and payment is made in accordance with Section 12 of the ANSTO Act 1987.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Included in Salaries expenses in Note 4 are:
Aggregated amount of superannuation payments in connection with the retirement of Members of the Board 19,843 19,214
Other remuneration received or due and receivable by the Members of the Board 264,417 244,825

The number of Members included in these figures is shown below in the relevant remuneration bands:

<table>
<thead>
<tr>
<th>Remuneration between</th>
<th>Number</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10,000 and $19,999</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>$20,000 and $29,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$30,000 and $39,999</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>$170,000 and $179,999</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>$180,000 and $189,999</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>
19 REMUNERATION OF EXECUTIVES

Executive remuneration is determined by the ANSTO Award. Included in salaries expenses is total remuneration received, or due and receivable, by executives (excluding the Executive Director who is included in Note 18) who earn $100,000 or more in connection with the management of ANSTO.

The number of executives (excluding the Executive Director who is included in Note 18) whose remuneration for the financial year falls within the following bands:

<table>
<thead>
<tr>
<th>Remuneration between</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100,000 and $109,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$110,000 and $119,999</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>$120,000 and $129,999</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>$130,000 and $139,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$140,000 and $149,999</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>$150,000 and $159,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$160,000 and $169,999</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$170,000 and $179,999</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$180,000 and $189,999</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The number of executives (excluding the Executive Director who is included in Note 18) whose remuneration for the financial year falls within the following bands:

<table>
<thead>
<tr>
<th>Remuneration between</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100,000 and $109,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$110,000 and $119,999</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>$120,000 and $129,999</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>$130,000 and $139,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$140,000 and $149,999</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>$150,000 and $159,999</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$160,000 and $169,999</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$170,000 and $179,999</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$180,000 and $189,999</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

20 INSURANCE

ANSTO is self insured, except for professional indemnity, public and product liability, industrial special risk for a property used substantially for commercial purposes, directors and officers, and motor vehicle third party property risk which are covered by commercial insurance, and workers compensation which is covered by statute under the Safety Rehabilitation and Compensation Act 1988.

The above insurance strategy is predicated on the Commonwealth's insurance principles, which require claims or losses derived from insurable risk associated with commercial activities to be covered by commercial insurance, with other claims and losses subject to consideration for acceptance by the Commonwealth on a case by case basis. (Refer Note 1)

21 REMUNERATION OF AUDITORS

Remuneration to the Auditor-General for auditing the financial statements for the reporting period

<table>
<thead>
<tr>
<th>Remuneration</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>92,000</td>
<td>92,000</td>
</tr>
</tbody>
</table>

No other services were provided by the Auditor-General during the reporting period.
22 RELATED PARTY DISCLOSURES

The Members of the Board during the financial year and to the date of the report on the statements were:

<table>
<thead>
<tr>
<th>Member</th>
<th>Term Appointed</th>
<th>Term Concluded</th>
<th>Term Concludes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Ashe</td>
<td>5 July 1996</td>
<td>30 June 1997</td>
<td></td>
</tr>
<tr>
<td>C R Ward-Ambler</td>
<td>5 July 1996</td>
<td>31 December 1996</td>
<td></td>
</tr>
<tr>
<td>G Taylor AO</td>
<td>5 July 1996</td>
<td>31 January 1997</td>
<td></td>
</tr>
<tr>
<td>J Bell (alternate to G Taylor)</td>
<td>5 July 1996</td>
<td>31 January 1997</td>
<td></td>
</tr>
<tr>
<td>H M Garnett</td>
<td>11 May 1995</td>
<td>10 May 2000</td>
<td></td>
</tr>
<tr>
<td>M H Codd AC</td>
<td>5 July 1996</td>
<td>30 June 1999</td>
<td></td>
</tr>
<tr>
<td>S M Richards</td>
<td>5 July 1996</td>
<td>30 June 2001</td>
<td></td>
</tr>
<tr>
<td>F A Khafagi</td>
<td>14 May 1997</td>
<td>31 December 1999</td>
<td></td>
</tr>
</tbody>
</table>

For the 1996-97 financial year the aggregate remuneration paid to Board Members is disclosed in Note 18.

The aggregate of superannuation payments paid to the Commonwealth Superannuation Scheme (CSS) and Public Sector Superannuation Scheme (PSS), in connection with the retirement of Members of the Board was $19,843 (1995-96 $19,214).

Other Transactions with Members of the ANSTO Board or their Member-related Entities

All transactions with related parties are made on commercial terms and conditions, except where stated.

The aggregate amount brought to account in respect of the following types of transactions with Members of the ANSTO Board and their member-related entities were:

<table>
<thead>
<tr>
<th>Transaction Type</th>
<th>Members Concerned</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of services by Bligh Oil &amp; Mining</td>
<td>S M Richards</td>
<td>173</td>
<td></td>
</tr>
<tr>
<td>Sale of goods and services by CSIRO</td>
<td>S M Richards</td>
<td>714,324</td>
<td></td>
</tr>
<tr>
<td>Sale of goods and services by CSIRO</td>
<td>C R Ward-Ambler</td>
<td>9,173</td>
<td>710,974</td>
</tr>
<tr>
<td>Provision of services by TELSTRA</td>
<td>M Codd</td>
<td>901,216</td>
<td></td>
</tr>
<tr>
<td>Provision of services by QANTAS</td>
<td>M Codd</td>
<td>1,051,534</td>
<td></td>
</tr>
<tr>
<td>Provision of services by IBM</td>
<td>M Codd</td>
<td>2,237</td>
<td></td>
</tr>
<tr>
<td>Provision of services by DIST</td>
<td>G Taylor</td>
<td>17,540</td>
<td></td>
</tr>
<tr>
<td>Services provided to Labour Council of N.S.W.</td>
<td>B Ashe</td>
<td>7,200</td>
<td></td>
</tr>
<tr>
<td>Purchase of goods and services from AMRAD</td>
<td>C R Ward-Ambler</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Services provided to CSIRO</td>
<td>S M Richards</td>
<td>1,406,930</td>
<td></td>
</tr>
<tr>
<td>Services provided to CSIRO</td>
<td>C R Ward-Ambler</td>
<td>1,330,334</td>
<td></td>
</tr>
<tr>
<td>Services provided to TELSTRA</td>
<td>M Codd</td>
<td>378</td>
<td></td>
</tr>
<tr>
<td>Services provided to QANTAS</td>
<td>M Codd</td>
<td>3,750</td>
<td></td>
</tr>
<tr>
<td>Services provided to DIST</td>
<td>G Taylor</td>
<td>125,951</td>
<td></td>
</tr>
</tbody>
</table>
FINANCIAL STATEMENTS

23 TRUST MONEY

Monies received by ANSTO for specific purposes are placed in special bank accounts and are expended for these specified purposes only. These monies are not recognised in the financial statements.

Total
Balance 1 July 195 825
Add: Receipts during the year 5,171 735
Add: Interest received 41 41
Less: Expenditure 4,824 1,406
Balance 30 June 583 195

Represented by the following:

Trust Account
ANSTO receive monies from trade creditors as security deposits for contracts to be performed. These monies are held in a Trust Account and refunded to the respective trade creditors on satisfactory completion of contract.

Balance 1 July 9 493
Add: Receipts during the year 4 5
Add: Interest received 2 26
Less: Expenditure 6 515
Balance 30 June 9 9

Synchrotron
Contributions have been received from a consortium for the operation and development of the Australian Beamline Facility at Tsukuba, Japan. The Synchrotron Trust Account was established for this specific purpose.

Balance 1 July 68 312
Add: Receipts during the year 3 375
Add: Interest received 1 13
Less: Expenditure 72 632
Balance 30 June – 68

MNRF Synchrotron
ANSTO was the proponent organisation for a consortium seeking government funding for the establishment of the Australian Synchrotron Research Program under the Major National Research (MNRF) Program. An initial funding of $250,000 was provided by the Department of Industry, Science and Tourism in 1995-96 to assist in the establishment of the Program.

Balance 1 July 96 –
Add: Receipts during the year 5,076 250
Add: Interest received 36 –
Less: Expenditure 4,654 154
Balance 30 June 554 96
### NEDO Grant

ANSTO was appointed research coordinator in the “Interface Properties of Ceramics and Their Impact on Materials Functions” project under the NEDO International Joint Research Program. The NEDO Grant Trust account was established to fund the operations of the project.

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Balance 1 July</strong></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Add: Receipts during the year</strong></td>
<td>88</td>
<td>105</td>
</tr>
<tr>
<td><strong>Add: Interest received</strong></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Less: Expenditure</strong></td>
<td>88</td>
<td>105</td>
</tr>
<tr>
<td><strong>Balance 30 June</strong></td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

### Welfare Fund

Donations and contributions have been received in the past from the operations of the AAEC Welfare Fund. These are placed in the Welfare Fund Trust Account and expended on specific welfare items for ANSTO employees.

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Balance 1 July</strong></td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td><strong>Add: Receipts during the year</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Add: Interest received</strong></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Less: Expenditure</strong></td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Balance 30 June</strong></td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>
INDEPENDENT AUDIT REPORT

To the Minister for Science and Technology

Scope

I have audited the financial statements of the Australian Nuclear Science and Technology Organisation for the year ended 30 June 1997. The financial statements comprise:

• Statement by Directors;
• Operating Statement;
• Statement of Assets and Liabilities;
• Statement of Cash Flows;
• Schedule of Commitments;
• Schedule of Contingencies; and
• Notes to and forming part of the Financial Statements.

The members of the Board are responsible for the preparation and presentation of the financial statements and the information they contain. I have conducted an independent audit of the financial statements in order to express an opinion on them to the Minister for Science and Technology.

The audit has been conducted in accordance with Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing Standards, to provide reasonable assurance as to whether the financial statements are free of material misstatement. Audit procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial statements, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken to form an opinion as to whether, in all material respects, the financial statements are presented fairly in accordance with Australian Accounting Standards, other mandatory professional reporting requirements (Urgent Issues Group Consensus Views) and statutory requirements so as to present a view of the entity which is consistent with my understanding of its financial position, the results of its operations and its cash flows.

The audit opinion expressed in this report has been formed on the above basis.
Audit Opinion

In accordance with section 63M of the Audit Act 1901, I now report that the financial statements are in agreement with the accounts and records of the Australian Nuclear Science and Technology Organisation, and in my opinion:

(i) the statements are based on proper accounts and records;

(ii) the statements present fairly, in accordance with applicable Accounting Standards and other mandatory professional reporting requirements, the financial transactions and results, and cash flows, for the year ended 30 June 1997 and the state of affairs of the Organisation as at that date;

(iii) the receipt, expenditure and investment of moneys, and the acquisition and disposal of assets, by the Organisation during the year have been in accordance with the Australian Nuclear Science and Technology Organisation Act 1987; and

(iv) the statements are in accordance with the Guidelines for Financial Statements of Commonwealth Authorities.

Australian National Audit Office

[Signature]

Russ Chantler
Executive Director

For the Auditor-General

Sydney
2 September 1997
EQUAL EMPLOYMENT OPPORTUNITY

OBJECTIVES

• To ensure that Equal Employment Opportunity (EEO) principles and practices are actively incorporated with all people management activities

• To ensure that the structures and processes to implement EEO adjust to changing employment needs

• To confirm and communicate the vision that ANSTO's employment activities reflect the social justice needs of the 1990s

ACTIVITIES AND OUTPUTS

Childcare

Negotiations continued with a prospective developer for the construction of a childcare centre at ANSTO. The developer has experienced delays in obtaining the necessary approvals to enable construction to commence.

Employee Assistance Program (EAP)

ANSTO's EAP was revised. Psychologists from the firm Citipsych were contracted to provide a weekly, on-site support service to staff. A series of lunchtime seminars covering a range of issues relevant to the work and family lives of staff was introduced.

A course relating to the management of stress was provided to supervisors and managers. The training articulated the responsibilities of such staff to identify and manage stress within the workplace.

Recruitment

Intermittent reviews were undertaken of recruitment practices to ensure compliance with ANSTO EEO legislation and objectives. In addition, statistics were gathered on applications and appointments to the various career areas at ANSTO. Analysis of these figures revealed that technical and craftsperson vacancies are still dominated by male applicants. The situation for scientists is slowly changing, with more females applying for and being recruited to these positions.

STAFF NUMBERS AT 30 JUNE 1997

<table>
<thead>
<tr>
<th></th>
<th>Full Time</th>
<th></th>
<th>Part Time</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Executive Director</td>
<td>15</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate Executives</td>
<td>153</td>
<td>34</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Professional Officers</td>
<td>83</td>
<td>18</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Research Scientists</td>
<td>248</td>
<td>28</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Technical Officers</td>
<td>37</td>
<td>68</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Administrative Service Officers</td>
<td>68</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Craftspersons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>604</td>
<td>158</td>
<td>3</td>
<td>16</td>
</tr>
</tbody>
</table>

Total staff: 781
Number of temporary staff: 15 (included in 781 figure)

CORPORATE EXECUTIVE INFORMATION

Band 3 Corporate Executive - 3 full time male
Band 2 Corporate Executive - 7 full time male
Band 1 Corporate Executive - 5 full time male
Band 1 Corporate Executive - 1 full time female
**APPENDIX 1**

**EQUAL EMPLOYMENT OPPORTUNITY**

**SUMMARY OF EEO STATISTICS AS AT 30 JUNE 1997**

TOTAL STAFF = 781: Specific EEO data currently held for 352 staff

<table>
<thead>
<tr>
<th>Number employed</th>
<th>Percentage of total staff</th>
<th>Average salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>174</td>
<td>23%</td>
</tr>
<tr>
<td>Men</td>
<td>607</td>
<td>77%</td>
</tr>
</tbody>
</table>

Staff in specific employment categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Average Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>People with disabilities</td>
<td>26</td>
<td>$44,839</td>
</tr>
<tr>
<td>Aboriginal and Torres Strait Islanders</td>
<td>2</td>
<td>$43,264</td>
</tr>
<tr>
<td>Non-English speaking background</td>
<td>141</td>
<td>$46,134</td>
</tr>
</tbody>
</table>
In compliance with Section 8 of the Freedom of Information (FOI) Act (1982), the following is the annual statement on consultative arrangements, categories of documents maintained and facilities and procedures for access to documents relating to ANSTO. Details of the functions of the organisation, membership of the Board and decision making powers of the Board and the executive are provided elsewhere in the Annual Report.

ARRANGEMENTS FOR EXTERNAL PARTICIPATION

Bodies appointed under the ANSTO Act

The Safety Review Committee reviews and assesses the standards, practices and procedures adopted by ANSTO to ensure the safety of its operations. The committee consists of a chairperson and four members appointed by and reporting to the Minister. The majority of members are not ANSTO staff.

The Nuclear Safety Bureau, an independent body corporate, is responsible to the Minister for Health and Family Services for monitoring and reviewing the safety of nuclear plant operated by ANSTO and for providing technical advice to the Commonwealth on the safety of nuclear plant and related matters.

Liaison groups

Reference groups for ANSTO’s major strategic research and development projects assist in assessing and evaluating research and development activities. Members are drawn from industry, commerce, government, academia and ANSTO staff.

The Local Liaison Working Party (LLWP), established in 1967, comprises representatives from the NSW Police, NSW Ambulance, NSW Fire Brigades, NSW State Emergency Services, NSW Environment Protection Authority, NSW Department of Health, Australian Protective Services, Sutherland Shire Local Emergency Management Committee, St George - Sutherland District Emergency Management, and ANSTO, as well as an observer from the Nuclear Safety Bureau. It reviews procedures applicable to an accident at the Lucas Heights Science and Technology Centre which could have implications for the public.

Meetings are held every two months between local community groups and ANSTO with an independent facilitator to ensure exchange of information. Meetings between the Sutherland Council and the ANSTO Chairman and senior staff are held every three months to review and resolve current issues between the two organisations.

A Central Safety Coordinating Committee assists in developing, reviewing and implementing ANSTO’s occupational health and safety policies. Membership includes representatives of unions and staff associations, the NSW Labor Council and ANSTO.

ANSTO/State Government arrangements

ANSTO, located in New South Wales, liaises with a range of NSW departments and authorities responsible for safety, environmental planning and related matters. ANSTO has collaborative agreements with the States of Western Australia and Queensland.

Associated organisations

The Australian Institute of Nuclear Science and Engineering Incorporated, an association of ANSTO and 36 universities, arranges access by staff and students of Australasian universities and Institutes of technology to the major facilities at ANSTO.

Other arrangements

Less formal arrangements exist for discussions, exchange of views and/or collaboration with organisations outside the Commonwealth administration including local government authorities, universities, standards bodies, professional societies, unions and staff associations, industrial groups and international nuclear agencies.

CATEGORIES OF DOCUMENTS HELD

Computer software packages, computer print outs, technical books and reports, and International Nuclear Information System documents are available for purchase. Single copies of the Annual Report, the Lucas Heights News, Program of Research, Strategic Plans, ANSTO emergency plans, promotional literature and videos (under loan arrangements) are available on request.

Documents relating to decision-making processes include Cabinet documents about matters in which
ANSTO has an interest, ministerial correspondence and directions, ANSTO Board agenda, memoranda and decisions, deeds, legal contracts and formal agreements, minutes and submissions, employment, delegations, security, finance and accounting handbooks and manuals.

General correspondence includes ministerial briefs, speeches, conference papers for national and international meetings, parliamentary questions and answers, cables, telexes and facsimiles, and general records files. Technical documents held include scientific and technical reports and laboratory notes comprising patents and inventions, computer tapes and print-outs, plant and equipment operating manuals, maintenance, quality assurance and safety manuals, reactor operating authorisations, records and log books, radioisotope quality control procedures manuals, radioisotope catalogues and price lists, engineering service general records, nuclear material movement vouchers and accounting records, photographs and radiographs. Health and safety related documents include staff medical records, safety related survey records, film badge and radiological records, accident reports and emergency response procedures.

Administration documents held include personnel records such as staff promotion files, organisation and establishment reports, compensation files, word processor disk systems for administrative instructions and information storage, staff lists and classifications, accounting records, pay-roll, flexitime and overtime records, tender and contract documents, building plans, specifications and instructions, directives, orders, memoranda, bulletins, notices and information. Other documents held include drawing office records such as plans, microfilm and drawings, maps and photographs.

**FACILITIES FOR ACCESS**

FOI reading facilities can be provided in the Reception and Information Centre at the entrance to the Lucas Heights Science and Technology Centre. Other arrangements for access may be made by contacting The FOI Coordinator, ANSTO, Private Mail Bag 1, Menai, NSW 2234, Australia (e-mail rmh@ansto.gov.au).


The Deputy Executive Director, Director Corporate Services, and Director Government and Public Affairs have been appointed as authorised officers under Section 23 of the FOI Act.
ECONOMIC DEPENDENCY

ANSTO is economically dependent on government, requiring appropriation of money by Parliament to carry out its activities.

Compliance

ANSTO is subject to the provisions of the following Acts and Awards:

• Australian Nuclear Science and Technology Organisation Act, 1987
• Audit Act, 1901
• Public Service Act, 1922
• Long Service Leave (Commonwealth Employee’s) Act, 1976
• Superannuation Act, 1976
• Superannuation Act, 1990
• Superannuation (Productivity Benefit) Act, 1988
• Superannuation Guarantee (Administration) Act, 1992
• Maternity Leave (Commonwealth Employees) Act 1987
• Australian Nuclear Science and Technology Organisation (General Award) 1990
• Australian Government Statutory Authorities Redeployment and Retirement (Redundancy Award) 1988

The functions of the Board

The organisation is managed by a Board established under Section 8 of the ANSTO Act.

Its general functions, set out in Section 9 of the Act, are to:

• ensure the proper and efficient performance of the functions of the organisation and
• determine the policy of the organisation with respect to any matter, having regard to the current policies of the Commonwealth Government.

In particular it has responsibility for:

• approval of organisational strategy and the annual business plan and budget
• monitoring financial performance
• monitoring managerial performance and
• ensuring that the significant risks facing the organisation have been identified and that appropriate control, monitoring and reporting mechanisms are in place.

The Board has established several committees to assist in the execution of its duties and allow detailed consideration of complex issues. Details of these are included below. Committees operate under written terms of reference. All matters considered and determined by committees are submitted to the Board for information and, where appropriate, ratification.

Board membership

The Board currently comprises four non-executive members, drawn from the broader community, and the Executive Director. The non-executive members are appointed by the Governor-General. The Executive Director is appointed by the Board. Section 19 of the ANSTO Act provides that the Executive Director shall manage the affairs of the organisation subject to the directions of, and in accordance with, policies determined by the Board.

Each member brings complementary skills and experience to the Board. During the 1996-97 financial year the experience of the Board members included industry, manufacturing, scientific research, union leadership, medicine and primary production.

Ten Board meetings were held during the financial year. The number of Board meetings held and attended during the period in which each member held office are provided in the table over.
APPENDIX 3

Member

C R Ward-Ambler (Resigned as Chairman and Member 31/12/96)
S M Richards (Appointed Chairman 1/1/97)
M H Codd AC
A K Gregson
B Ashe (Resigned 30/6/97)
F A Khafagi (Appointed 14/5/97)
H M Garnett (Executive Director)
G Taylor AO (Resigned 31/1/97)
J. Bell (alternate to G Taylor)

MEETINGS

Held
Attended
6
5
10
9
10
9
10
8
10
7
1
-
10
8
2
1
4
4

Remuneration and allowances

Non-executive members' remuneration and allowances are determined by the Remuneration Tribunal.

Disclosure of interests

Section 15 of the ANSTO Act provides for the disclosure of direct or indirect interests in matters considered by the Board and prohibits participation and deliberation and decision making by any member on such matters.

Independent professional advice

The Board has established procedures by which members may seek independent professional advice.

Safety

The Board places primary importance on the safe performance of all ANSTO activities. The monitoring of safety in general, and compliance with relevant legislation in particular, is designated as a responsibility of the Board as a whole. The Board is assisted in fulfilling its duties by the activities and reports of two external bodies.

The Nuclear Safety Bureau, established through an amendment to the ANSTO Act in 1992, regulates the manner in which the nuclear research reactors in Australia - HIFAR and Moata - are operated and reports to its responsible Minister as appropriate. The Moata reactor has been shut down and a decommissioning plan is being developed. The Nuclear Safety Bureau will continue to monitor activities during decommissioning.

A Safety Review Committee, appointed by the responsible Minister, monitors safety activities at ANSTO and reports to the Minister on an annual basis.

Audit Committee

The Audit Committee, a formal sub-committee of the Board, comprises Mr M. Codd (Chairman), Dr A. Gregson and a member external to ANSTO, Mr J. Bergman. The Executive Director, the Director, Corporate Services, the Chief Internal Auditor and representatives of the Australian National Audit Office attend meetings at the invitation of the Committee Chairman.

This Committee was established by the Board to oversee the Organisation's risk management policies, practices and controls in relation to financial and commercial activities, legislative and regulatory conformance and asset protection. The Committee also reviews the internal and external audit work programs and reports.

Seven Audit Committee meetings were held during the financial year. The number of Committee meetings held and attended during the period in which each member held office during the financial year are provided in the table opposite. The Committee generally meets quarterly and is the only sub-committee of the Board.
APPENDIX 3

MEMBER

S M Richards (Resigned as Chairman and Member on 31/12/96)
M H Codd AC (Appointed as Chairman 1/1/97)
A K Gregson (Appointed 18/3/97)
B Ashe (Resigned 30/6/97)
J Bergman (External Member)

MEETINGS

Held       Attended
5          4
7          6
2          2
7          4
7          7

Technical Advisory Committee

The Technical Advisory Committee, a committee formally established in accordance with a Board decision, comprises four members, all of whom are external to ANSTO. Members are chosen on the basis of internationally recognised scientific expertise and experience.

This committee was established by the Board to:

• advise on the scope of ANSTO's scientific research program
• advise on ANSTO's ability to achieve the scientific goals of its Mission, and
• review the progress of ANSTO's research against defined milestones and objectives.

The Committee was formally constituted in October, 1996 and met once during the period to 30 June, 1997. The Committee is required to meet at least once a year.

Risk management

The Board recognises that developing and implementing ANSTO's strategies requires careful assessment and balancing of both risk and opportunity. The Board is charged with the responsibility for ensuring that appropriate policies are in place to cover identified risks and management is required to develop appropriate procedures to manage these risks.

During the year management, in consultation with the Board Audit Committee, undertook a review of the organisation's business risks. It covered activities in all Divisions and addressed risks with potential to prevent the organisation from achieving its business objectives. As a result, a new risk management policy is being drafted by management for consideration and endorsement by the Board.

Where possible and in appropriate circumstances, insurance is used as a method to transfer the financial impact of risk.

Ethical standards

In May 1997 the Board approved a policy document, 'Ethics and Conduct - A Code for ANSTO Staff'. The policy provides a reference point for ethical behaviour and applies to members of the Board, management and all staff. The Code sets out the standards for ethical behaviour and conduct and provides guidance by defining the expected values and standards of workplace behaviour and performance.

Fraud control

In accordance with the Government's fraud control policy, the Board commissioned a fraud risk assessment of the organisation which will give rise to a fraud control plan for consideration and adoption by the Board.
Functions of the Organisation under the
Australian Nuclear Science and Technology
Organisation Act 1987 (the ANSTO Act)

‘Organisation’ means the Australian Nuclear Science
and Technology Organisation.

Section 5 of the ANSTO Act provides that:

(1) The functions of the Organisation are:

(a) to undertake research and development in
relation to:

(i) nuclear science and nuclear technology;

(ii) the production and use of radioisotopes,
and the use of isotopic techniques and
nuclear radiation, for medicine, science,
industry, commerce and agriculture; and

(iii) such other matters as the Minister
directs;

(b) to encourage and facilitate the application and
utilisation of the results of such research and
development;

(ba) to condition, manage and store radioactive
materials and radioactive waste, arising from:

(i) the Organisation’s activities (including
the production of radioactive materials for
other persons); or

(ii) the activities of companies in which the
Organisation holds a controlling interest
(including the production of radioactive
materials for other persons); or

(iii) the use by other persons of radioactive
materials produced by the Organisation or
such companies; or

(iv) the activities of other persons who are
specified in the regulations;

(c) to provide and sell goods (whether produced
by the Organisation or purchased or otherwise
acquired by the Organisation) and services:

(i) in connection with the production and
use of radioisotopes, and the use of
isotopic techniques and nuclear radiation,
for medicine, science, industry, commerce
and agriculture; or

(ii) otherwise in connection with matters
related to its activities;

(d) to act as a means of liaison between Australia
and other countries in matters related to its
activities;

(e) to provide advice on aspects of nuclear science
and nuclear technology and other matters related
to its activities;

(ea) to make available to other persons, on
a commercial basis, the knowledge,
expertise, equipment and facilities of the
Organisation by:

(i) providing training and management
expertise; or

(ii) selling or leasing equipment; or

(iii) leasing land and facilities; or

(iv) taking any other action that the
Organisation thinks appropriate;

(f) to co-operate with appropriate authorities of
the Commonwealth, the States and Territories, and
with other organisations and institutions in
Australia or elsewhere, in matters related to its
activities;

(g) to publish scientific and technical reports,
periodicals and papers on matters related to its
activities;

(h) to collect and sell or distribute, as appropriate,
information and advice on matters related to its
activities;

(j) to arrange for training, and the establishment
and award of scientific research studentships and
fellowships, in matters related to its activities;

(k) to make grants in aid of research into matters
related to its activities; and

(m) to make arrangements with universities and
other educational research institutions,
professional bodies and other persons for the
conduct of research or of other activities in
matters related to its activities.
(1A) A regulation made for the purposes of subparagraph (1)(ba)(iv) must not have the effect of authorising the premises on which the Lucas Heights Research Laboratories [the Lucas Heights Science and Technology Centre] are situated to become a national nuclear waste repository.

(1B) In subsection (1A): ‘national nuclear waste repository’ means a site chosen by the Commonwealth, after the commencement of this subsection, for the storage of nuclear waste with a view to it never being moved to another site.

(2) The Organisation shall not undertake research or development into the design or production of nuclear weapons or other nuclear explosive devices.

(3) In undertaking its functions, the Organisation is to have regard to:

(a) the Commonwealth Government’s national science, technology and energy policy objectives; and

(b) the Commonwealth Government’s commercialisation objectives for public research institutions.

General powers of the Organisation under the ANSTO Act

Section 6 of the ANSTO Act provides that:

(1) Subject to this Act, the Organisation has power to do all things necessary or convenient to be done for or in connection with the performance of its functions and, in particular, has power:

(a) to enter into contracts;

(b) to acquire, hold and dispose of real or personal property;

(c) to occupy, use and control any land or building owned or held under lease by the Commonwealth and made available for the purposes of the Organisation;

(d) to erect buildings and structures and carry out works;

(e) to form, or participate in the formation of, a company or partnership;

(f) to appoint agents and attorneys, and to act as an agent for other persons;

(g) to engage persons to perform services for the Organisation;

(h) to design, produce, construct and operate equipment and facilities; and

(j) to do anything incidental to any of its powers.

(2) The powers of the Organisation may be exercised within or outside Australia.
## APPENDIX 5

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<td>AMS</td>
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<td>Advanced Technical Development</td>
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<td>AUSANS</td>
<td>Australian Small Angle Neutron Scattering Instrument</td>
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<td>BAPEDAL</td>
<td>Indonesian Environmental Protection Agency (translation)</td>
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<td>CAM</td>
<td>computer aided manufacture</td>
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<tr>
<td>CERN</td>
<td>European Laboratory for Particle Physics (translation)</td>
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<td>computational fluid dynamics</td>
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<td>Commonwealth Superannuation Scheme</td>
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<td>EEO</td>
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<td>FIMS</td>
<td>Financial Information Management System</td>
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<td>FOI</td>
<td>Freedom of Information</td>
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<td>GIRD</td>
<td>Generic Industrial Research and Development</td>
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<td>HIFAR</td>
<td>High Flux Australian Reactor</td>
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<td>International Atomic Energy Agency</td>
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<td>ICNCA</td>
<td>International Conference on Nuclear Cooperation in Asia</td>
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<td>INIS</td>
<td>International Nuclear Information System</td>
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<tr>
<td>JAERI</td>
<td>Japan Atomic Energy Research Institute</td>
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<td>Japanese International Co-operation Agency</td>
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<td>KAERI</td>
<td>Korea Atomic Energy Research Institute</td>
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<td>KEK</td>
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<td>KPPL</td>
<td>Jakarta City Government Urban and Environmental Study Office (translation)</td>
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<td>Local Liaison Working Party</td>
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<td>Major National Research Facility</td>
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<td>Nuclear Energy Agency</td>
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<td>National Medical Cyclotron</td>
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<td>Office for Atomic Energy for Peace</td>
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<td>Organisation of Economic Co-operation and Development</td>
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<td>Oak Ridge National Laboratory</td>
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<td>PCI</td>
<td>Pollution Control Implementation</td>
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<td>Positron Emission Tomography</td>
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<td>Public Sector Scheme</td>
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<td>Single Photon Emission Computed Tomography</td>
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<td>Technical Advisory Committee</td>
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<tr>
<td>TCDC</td>
<td>Technical Cooperation among Developing Countries</td>
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<td>USGS</td>
<td>United States Geological Survey</td>
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<td>United States Nuclear Regulatory Commission</td>
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