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Annual Report 1994 - 1995

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Cover

A Secondary Ion Mass Spectrometry image of calcium phosphate granules in the soft tissue of a freshwater mussel. Since many pollutants, including radioactivity from uranium mining sites, are incorporated into these granular deposits, mussels are used by ANSTO's Environmental Science Program for monitoring the quality of waterways throughout Australia.

Annual Report 1994 - 1995



AUSTRALIAN NUCLEAR SCIENCE AND
TECHNOLOGY ORGANISATION

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21 September 1995

Senator the Hon Peter Cook
Minister for Industry, 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 1994 to 30 June 1995.

Audited Group financial statements for the year ended 30 June 1995 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

A handwritten signature in black ink, appearing to read 'C R Ward-Ambler', written in a cursive style.

C R Ward-Ambler
Chairman.

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ANSTO'S Mission

ANSTO's mission is to ensure that its research, technology transfer, commercial and training activities in nuclear science and associated technologies will advance Australia's innovation, international competitiveness and environmental and health management.

ANSTO will also maintain and further develop its scientific and technological resources and operate as a national centre for science and technology to advance Australia's national and international nuclear policies and interests.

Enabling Legislation

The Australian Nuclear Science and Technology Organisation (ANSTO) is a body corporate established by the Australian Nuclear Science and Technology Organisation Act 1987 as amended by the Australian Nuclear Science and Technology Organisation Amendment Act 1992. The functions and powers of ANSTO are set out in Part 2, Section 5 and 6 of the Australian Nuclear Science and Technology Organisation Act 1987 and Section 4 of the Australian Nuclear Science and Technology Organisation Amendment Act 1992.

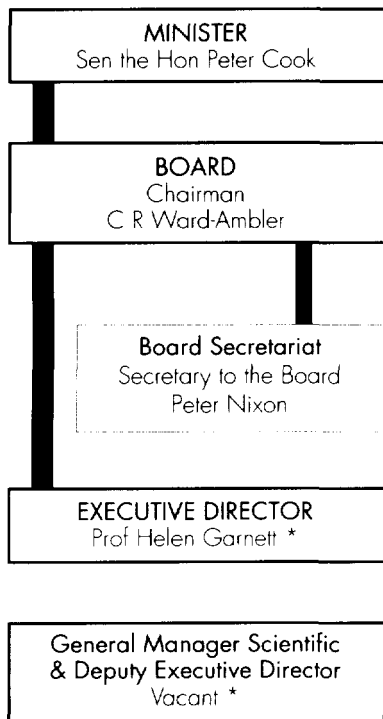
Organisational Highlights

- The recommendations of a comprehensive review of the Organisation were presented to the ANSTO Board in December 1994. The Board is of the firm view that implementation of the recommendations will result in a reinvigorated ANSTO directed by a clear mission and focussed on serving the needs of its stakeholders and customers.
- To exploit complementary skills and facilities in the national interest, a protocol was signed with the CSIRO Division of Materials Science and Technology on cooperative relationships in research and development in advanced materials.
- ANSTO strengthened its scientific and commercial linkages to further the development of Synroc. Research contracts funded by the US Department of Energy were successfully completed on high level radioactive waste remediation with Pacific Northwest Laboratories, Hanford, USA.
- A new multi-sampling high intensity ion source on the ANSTO tandem accelerator enabled dating of samples up to 5 000 years old with an accuracy of 0.5% using the carbon-14 technique.
- A massive database obtained from a two year, 24-site monitoring program provided new information on the distribution, composition and sources of fine particles in the atmosphere in the major urban areas of NSW. It will assist Government and local authorities to establish guidelines for protecting community health and living standards.
- A computer program, CEQUIL, for modelling geochemical processes in the environment, was completed. The program was successfully applied to modelling the movement of contaminated groundwaters from the uranium mines of WISMUT GmbH, in eastern Germany.
- ANSTO became a full partner in the Australian Centre for Minesite Rehabilitation Research, with responsibility for developing and managing a collaborative research program on acid mine drainage.
- An innovative arsenic treatment process was developed by ANSTO through the Cooperative Research Centre for Waste Management and Pollution Control Ltd. The United States Environmental Protection Agency has shown a strong interest in the process and is funding a \$A1m demonstration project to treat wastes from a smelter in Montana.
- ANSTO conditioned radioactive waste stored at the Australian Defence Industries site at St Marys, Sydney, and facilitated its safe transport to Woomera, South Australia.
- Biomedicine and Health Program moved into a new \$3.3m research laboratory. It will assist improved health care in Australia through the development of new diagnostic and therapeutic radiopharmaceuticals by ANSTO scientists.

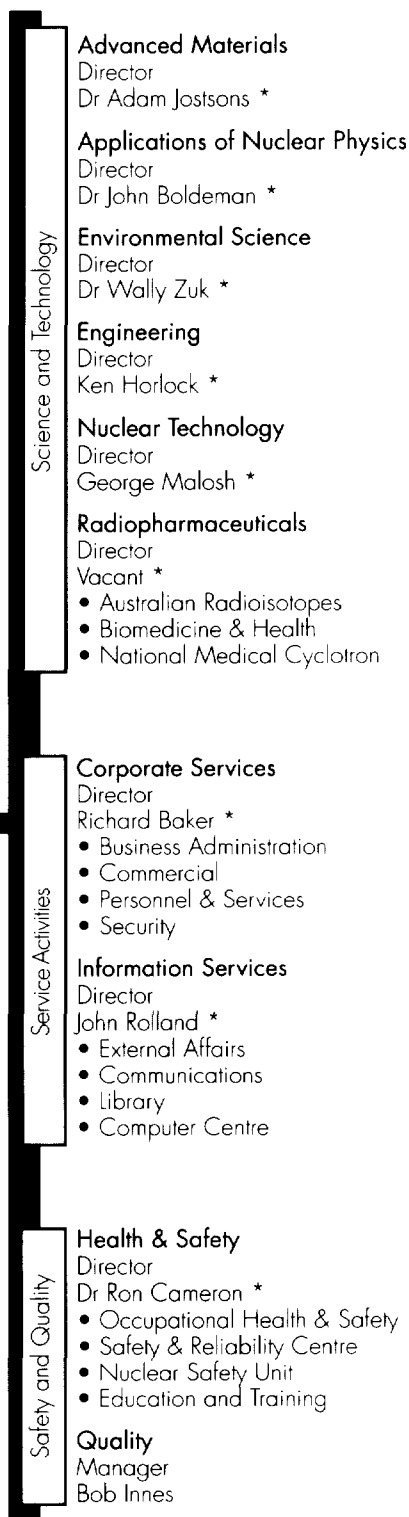
- A pilot study at the Illawarra Regional Hospital of a radiolabelled monoclonal antibody has shown promise in the diagnosis of ovarian cancer and in monitoring its recurrence.
- Specialised pivot roller bearing assemblies were designed and manufactured for the coarse control arms used to control the nuclear fission rate in the reactor HIFAR.
- Record sales by Australian Radioisotopes reflected the continuing strong growth of nuclear medicine procedures in Australia.
- The National Medical Cyclotron met most of Australia's needs for cyclotron produced radiopharmaceuticals, reducing reliance on imports.
- The documentation relating to the Authorisation - HIFAR Operations was completed in accordance with the requirements of the Nuclear Safety Bureau.
- Development of a formal quality system and increased attention to customer satisfaction resulted in record income of \$2.2m from overseas customers for the irradiation of silicon ingots in HIFAR for semiconductor applications.
- ANSTO provided health physics coverage for all field operators associated with the clean-up of the former British atomic weapons testing site at Maralinga in South Australia.
- Updated site and district emergency planning documents, developed in conjunction with NSW emergency response agencies, were widely distributed.
- An Information Management Strategic Plan was developed. It recognises that effective information management is an essential element in supporting ANSTO's scientific and commercial activities.
- New community interaction processes, including regular meetings with the Sutherland Shire Council and with community representative organisations, was put into place to enhance understanding of ANSTO's activities.
- A Triennium Funding (Resource) Agreement was agreed to by the Federal Government. This Agreement provides financial certainty and facilitates longer term planning of resource allocations.
- Ratification of the second Enterprise (Bargaining) Agreement, 1995, took effect from 29 December 1994. The implementation of this Agreement resulted in a stable industrial relations environment.

Organisation Chart

June 1995



* Member of Senior Management Committee



Members of the Board



Prof Helen Garnett

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

Dr Tony Gregson

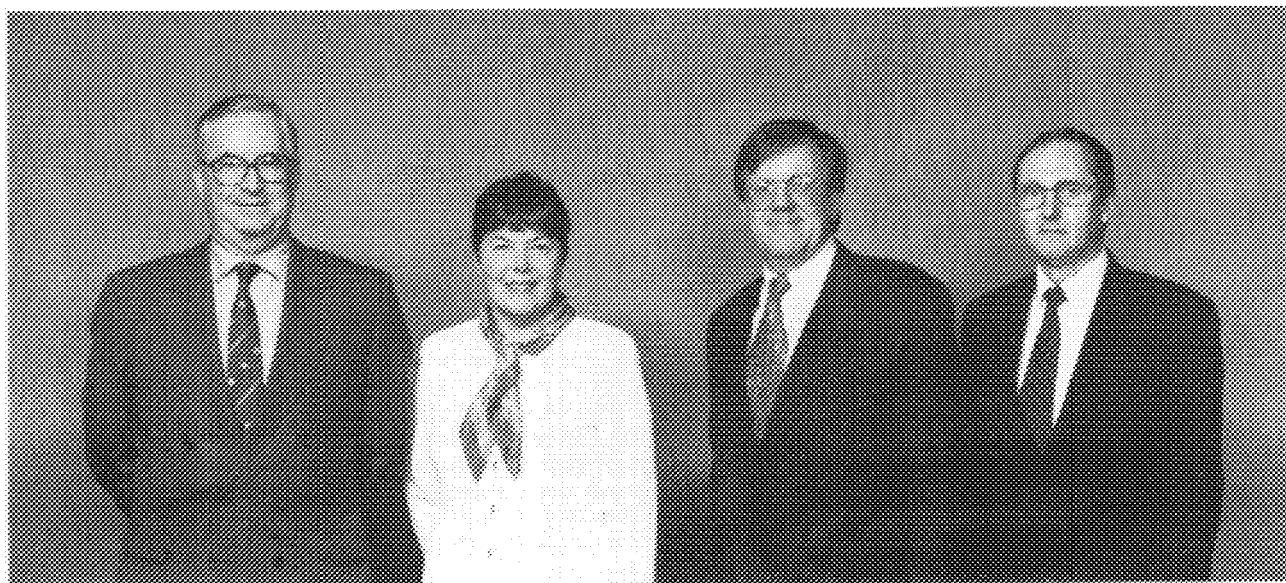
Primary producer,
Company Director,
appointed on 2
December 1993 until
30 June 1996.

Ralph Ward-Ambler

(Chairman), Company
Director, appointed on 2
December 1993 until 30
June 1996.

Secretary to the Board, Peter Nixon.

There were nine ANSTO Board meetings during the year.



Dr Don Williams

(Deputy Chairman),
Company Director,
appointed on 2
December 1993 until 30
June 1996.

Beryl Ashe

Executive Officer, Labor
Council of NSW,
appointed on 1 January
1993 until
30 June 1996.

Sandy Hollway

Secretary, Department of
Industry, Science and
Technology, appointed
on 20 December 1993
until 30 June 1996.

Dr Colin Adam

Director, Institute of
Industrial Technologies,
CSIRO, appointed on 2
December 1993 until 30
June 1996.

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Chairman's Report

It is with great pride that I present to you the Annual Report for ANSTO for 1994-95. During the year, the Board addressed a number of complex issues aimed at achieving a creative and valuable future for ANSTO in its service to national objectives and the Australian community.

By the beginning of the financial year, an uncertain environment had developed around ANSTO. The Board felt uncertainty with regard to the ability to sustain the required range of skills, while there were concerns within government and the Board that ANSTO may be too diverse in its activities, causing some of these to overlap with those of other science organisations. For this reason, the Board commissioned a substantial study, undertaken by Bain International and the Battelle Memorial Institute, with the brief to combine strategic and scientific skills and make recommendations on:

- an appropriate focussed mission for ANSTO;
- those areas of science relevant to the mission in which ANSTO has the opportunity to participate at levels of world excellence; and
- any scientific projects requiring improved coordination with other science organisations.

The Board and senior management were deeply involved in this study during the first half of the financial year. At its December meeting, the Board accepted the underlying principles of most recommendations as a basis for implementation. A number of matters that impinged on government policy were referred to the Minister.

A key realisation emerging from the review was the importance of a replacement for the HIFAR reactor, both to provide a current technology facility for neutron based research and radioisotope production and also to ensure that ANSTO retains a high level of expertise in reactor technologies in the national interest. HIFAR was

commissioned in 1958 and whilst the cost of replacement is high, there is also a high cost in dollars, and lost skills and opportunities, in deferral of replacement. In this respect, the Nuclear Safety Bureau has called on ANSTO to provide its detailed plans to ensure that HIFAR continues to operate safely after 2003. Initial estimates indicate to the Board that this will be costly.

An additional principal outcome of the Mission Review was guidance with respect to management and organisation. The Board considered the role of the Executive Director and advertised widely for applications within Australia and internationally. After a substantial round of interviews, Professor Helen Garnett was appointed Executive Director for a five year term from 11 May 1995. Professor Garnett was previously General Manager (Scientific) and had been Acting Executive Director for a year prior to her appointment.

In line with best practice, the Board has established an Audit Committee to serve as a sub committee of the Board. In addition to review of financial prudence, the Audit Committee will review risk assessment issues and will be receiving a commissioned external report on that subject at its meeting in July 1995.

On the scientific and technology front, some of the major achievements of the year have been:

- development of a computer code, known as CEQUIL, for modelling geochemical processes in the environment was completed. The program was successfully applied to the modelling of contaminated groundwaters from the uranium mines of WISMUT GmbH, in eastern Germany;
- development of a new process for the treatment and immobilisation of arsenic waste from ore processing which the US Environmental Protection Agency has agreed to fund as a demonstration project;

- positive results from a pilot study of a radiolabelled monoclonal antibody in the diagnosis of ovarian cancer;

- design and manufacture of specialised pivot roller bearing assemblies for the coarse control arms used to control the nuclear fission rate in HIFAR. The bearing assemblies, no longer obtainable either in Australia or overseas, are essential to the continued safe operation of HIFAR;

- to exploit complementary skills and facilities in the national interest, a protocol was signed with the CSIRO Division of Materials Science and Technology on cooperative relationships in research and development in advanced materials; and

- a massive database obtained from a two year, 24-site monitoring program provided new information on the distribution, composition and sources of fine particles in the atmosphere in the major urban areas of NSW. It will assist Government and local authorities to establish guidelines for protecting community health and living standards.

In addition to producing excellent science, ANSTO also has the responsibility of maintaining and enhancing national facilities which are used not only by ANSTO staff, but also by students and scientists from universities and other science agencies in Australia and elsewhere. HIFAR, the tandem accelerator, the National Medical Cyclotron and the Secondary Ion Mass Spectrometry facility all fall into this category. Equipment for use with the tandem accelerator was enhanced during the year. Further, the Board approved the construction of an additional target room at the Cyclotron and endorsed plans for upgrading various waste management facilities on the ANSTO site.

ANSTO continues to store the spent fuel arising from HIFAR on site. The Board remains concerned about the need for early decisions on the management of spent fuel from the research reactors as well as the location of a national low level radioactive waste repository. To this end, ANSTO will continue to work closely with Government Departments and agencies. The Board has strongly supported a probabilistic safety assessment on HIFAR, a recommendation from the Research Reactor Review.

It remains important for ANSTO to retain and promote open communication with the public and, in particular, the local authorities. The Executive Director and I met on three occasions during the year with representatives of the Sutherland Shire Council to discuss issues of concern to the Shire and to ANSTO. It is inevitable and understandable that many of these issues are ones of safety and environmental protection and ANSTO accepts that while it aims for the world's best practice, it is equally important that all steps taken to attain these be understood by the local community.

A comprehensive draft Communications Strategy was considered by the Board and while elements of it are being implemented already, other recommendations will be analysed further and taken up in a long term action plan.

ANSTO is at an exciting time in its history. It has the impetus of a Mission Review and it has a new Executive Director who has her own new vision for ANSTO. It has put on the table of Government a number of important matters which require decisions that will have a major effect on the future of ANSTO. It needs to follow through in the new financial year with the recommendation to place Australian Radioisotopes (ARI) on a proper commercial footing. There is exciting scientific opportunity and there are challenging tasks ahead for all ANSTO staff.

Early in the new financial year, the Board will receive a major presentation from the new Executive Director on her vision for ANSTO and how she intends to bring the ANSTO mission to life through excellent, focussed science achieving objectives important to Australian industry and science and to the national community. This vision statement will give rise to a new strategic plan for ANSTO.

In these endeavours, I and my Board look forward with great confidence to working with Helen Garnett and her ANSTO team to meet these challenges.

C Ralph Ward-Ambler
Chairman

Annual Directors Report

A National Laboratory such as ANSTO is under constant pressure to meet the demands of many stakeholders, particularly those of its major stakeholder, the Government. It is therefore timely that the Mission Review has questioned the extent of this diversity. The review identifies three main objectives for ANSTO, namely:

- support for the Government's nuclear policies;
- contribution towards industrial competitiveness and innovation; and
- the development of a high quality nuclear science base through maintenance of unique facilities and expertise to which academic institutions and other science organisations can have access.

I refer briefly to some of the activities of the past year which have been directed towards achieving these objectives and improving the operational effectiveness of the Organisation.

ANSTO staff have participated on behalf of Australia in a number of nuclear related consultations and meetings in places as scattered as Tokyo, Seoul, Vienna, Paris and Kuala Lumpur. These discussions concerned regional cooperation in support of the extension of the Nuclear Non-Proliferation Treaty, safe operation of research reactors, radioactive waste management, storage of spent fuel, applied marine radioactivity studies, radiopharmaceuticals and nuclear safeguards. While Australia is not a nuclear power and does not use nuclear energy for power generation, ANSTO provides the Australian Government with the technical support required to keep it informed of developments in nuclear activities worldwide and in particular in the South East Asia Region, where nuclear activities are growing rapidly. ANSTO maintains technical staff in London, Washington and Vienna as a part of its international linkages. These staff are attached to the

Australian Embassies or, in the case of London, the Australian High Commission. They assist in facilitating Australia's contacts with the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) and in keeping Australia advised on important technical issues in nuclear science and technology.

During this financial year, a two-year review of the new arrangements for interaction between ANSTO and the universities represented by the Australian Institute of Nuclear Science and Engineering (AINSE) was completed. The outcome was positive in that the review supported the changes and acknowledged the benefits to both the universities and ANSTO. While ANSTO supports AINSE financially (\$906 000 for the year), it benefits significantly through the collaboration on projects, the networks established and the interaction with postgraduate students. The number of university projects undertaken at ANSTO exceeded 200 for the year, with the largest number involving accelerator mass spectrometry and neutron scattering projects. ANSTO values the links that exist between it and the universities and the opportunity to make available its unique facilities at Lucas Heights.

It would be surprising if a new Executive Director did not introduce processes to an Organisation which are distinctive of her style. It has been my objective while acting in this position, and subsequently on my appointment in May, to establish clear policies and processes to underpin the operational effectiveness and efficiency of the Organisation. Establishing these demanded considerable input from many persons within ANSTO and were facilitated by a small number of consultants. The cooperation of staff across ANSTO has been heartening.

A process whereby the Senior Management team meet regularly to consider current issues and draft policy documents has provided input, feedback and improved communications. The benefits of this process will be better policies and a shared understanding of the motivations for such policies. This strategy was particularly useful as the Organisation digested the contents of the Mission Review and projected the ramifications of alternative responses. New strategies for Communications, Information Management and Waste Management have been developed, and a different way of undertaking Enterprise Bargaining and a continual improvement process introduced.

A Culture Audit was undertaken for the Organisation early in 1995. Its purpose was to identify and later embed those key organisational values which will underpin the achievement of our Mission. The Audit exposed certain structures and procedures which are at odds with the culture needed for ANSTO to be an effective Organisation. Where these differences exist, tension is inevitable and strategies are required to reduce that tension. Subsequent workshops with senior management and cross-sections of staff, facilitated by an external consultant company, identified a series of measures to be taken throughout the Organisation. This process will be continued in conjunction with the implementation of the Enterprise Agreement in the new financial year.

A draft Communications Strategy was prepared after extensive discussions and consultation with both internal and external ANSTO stakeholders. The latter group included Sutherland Shire Councillors, the Sutherland Shire Environment Centre, local precinct committees, the media, science teachers, local schools and local residents. An important initiative commenced during the year is a series of liaison meetings with local community groups to seek their views on establishing channels which will effectively meet the community's information needs about ANSTO. ANSTO is sensitive to the difficulties of managing nuclear reactors,

even small research reactors, and will continue to work constructively to keep all interested groups informed as fully as possible about issues that could be of concern to the community, both local and further afield.

Information is at the very core of ANSTO's business and the rapidly expanding use that is made of electronic means to process, access, store and transfer information provides all complex organisations like ANSTO with the responsibility of managing that information effectively. A task force at ANSTO, after considerable consultation both internally and externally, prepared a draft Information Management Strategic Plan. The speed with which technology is changing makes it important that flexible processes are in place to respond to these changes.

Another project team prepared a revised, comprehensive Radioactive Waste Management Policy. ANSTO is committed to comply with all relevant legislative and regulatory requirements, to keep radiation exposures as low as reasonably achievable and to dispose of waste or store it in accord with international best practice. Further as clearly reflected in this Policy, ANSTO will commit itself to minimise waste generated and to ensure broad public understanding of the policies. Waste disposal depends on decisions to be made outside of ANSTO and often outside of Australia, but there is no reason why an integrated predisposal plan cannot be prepared. For each of the policy's directives, strategies and critical factors have been identified and actions indicated. This is an area of site management where ANSTO can, through developing effective management practices, aim to be at the forefront internationally. That is my intent for the Organisation.

Management and union representatives in the course of the year negotiated the second Enterprise Agreement which will remain in place until the end of October 1996. The process of reaching agreement was long and at times tortuous, but did have its own rewards in that management and staff were

obliged to examine each area of the Organisation's activities in an effort to locate areas where improvement through workplace reform can be achieved. With the Agreement now in place, there will be continuing focus to identify better ways of working as well as implementing the reforms and the tasks agreed to.

The transport of soil with slight radioactive contamination which had its origins at a laboratory in Melbourne and the conditioning and transport of some radioactive waste from St Marys in Sydney to Woomera in South Australia attracted much media interest. ANSTO, on behalf of the Departments and Agencies concerned, provided expert advice on the conditioning and transportation of the waste. These matters also focussed attention on the need for the establishment of a national radioactive waste repository to accommodate the waste at ANSTO and at many other sites around Australia. ANSTO has provided technical support to the relevant Departments charged with identifying the preferred site for such a facility.

The uncertainty at ANSTO to which I referred in the previous Annual Report has not entirely dissipated. There are many important decisions to be made over the coming months resulting from the recommendations of the Mission Review and the initiatives that we have taken. One of these involves the selection of topics of research, based on our unique capabilities, in which we can 'get to the future first', using our human resources and physical facilities to make major contributions to the benefit of Australia. Significant achievements have, however, been made during the past year across the Organisation as identified in the Organisational Highlights section at the commencement of this Report. I would instance the following:

- During the year, the Environmental Science Program became a full partner in the Australian Centre for Minesite Rehabilitation Research with responsibility for developing and managing a collaborative research program on acid mine drainage,

identified by the Australian mining industry as a major future environmental liability;

- The Synroc technology was chosen as one of the three technologies being assessed in the US demonstration program for the immobilisation of plutonium conducted at the Lawrence Livermore National Laboratory, USA; and
- Expansion in the use of the Accelerator Mass Spectrometry (AMS) service, both nationally and internationally, enabled major contributions in the understanding and remediation of severe environmental problems such as the greenhouse effect.

These achievements bear testimony to the capacity of ANSTO to contribute to the socioeconomic well being of Australia, a goal which will continue to influence the direction of ANSTO's research and development.

In selecting topics of research for the future and in their planning and execution, we will expand our links with CSIRO and other research organisations, with the universities and with industry as appropriate.

ANSTO is one of Australia's major national laboratories. It is my commitment for it to be recognised internationally for the outcomes of its science and technology.

Professor Helen M Garnett
Executive Director

Review of ANSTO's Mission

The ANSTO Board initiated a comprehensive review of the Organisation in May 1994. This was conducted by the consultants Bain International Inc, in conjunction with Battelle Memorial Institute, which operates a large multidisciplinary research establishment in the USA. The consultants' report was provided to the ANSTO Board in December 1994. The Board endorsed the general thrust of the recommendations but is considering thoroughly their implications prior to implementation.

The terms of reference of the Review were:

- develop a mission for ANSTO, defining its role domestically and internationally, taking into account the needs of ANSTO stakeholders, the capacity of ANSTO science and international opportunities;
- examine and recommend what appropriate non-nuclear research constitutes an efficient use of resources, and the leverage opportunities arising from ANSTO's unique capabilities and programs which complement the work of other Commonwealth organisations;
- consider the benefits of integration of certain ANSTO activities with those of other scientific organisations and vice versa;
- provide an appropriate structure for ANSTO to enable it to perform efficiently the activities consistent with the identified mission covering the management of the organisation, relevant performance measures, appropriate performance targets, and conclusions derived from stakeholders' expectations of ANSTO;
- identify the role ANSTO is expected to play with industry as well as its community service and national interest obligations;
- identify ANSTO's ability to become internationally competitive in particular fields;
- recommend a process to ensure that strategy development is rigorous and continuous.

The Process

The consultants carried out extensive interviews with ANSTO staff and its stakeholders from government, industry, academia, the medical community, special interest groups and unions. This permitted the development of an overall understanding of the needs of ANSTO's major stakeholder groups and the extent to which these needs were being satisfied. The relevance of ANSTO's activities in the context of current national policies was also analysed.

Interviews with several international nuclear science and technology organisations and science institutes in Europe, North America and Asia provided benchmarks for recent advances and trends in management of science organisations which could be applied to ANSTO.

Finally, ANSTO's scientific and technical capabilities were analysed and assessed in relation to stakeholder needs. This was done to enable the relative importance of all Programs to be established, permitting assessment of the need for, and range of, Program changes required to meet the mission objectives.

The Major Recommendations

The Review recommended the following objectives for ANSTO:

- support the Government's nuclear policy objectives;

- support industrial competitiveness and innovation through technology transfer;
- maintain a high quality nuclear science base, and enable academic institutions and other science organisations to perform research by providing access to ANSTO's unique facilities and expertise.

The Review recommended that the ANSTO research program should be focussed upon a small number of well-defined Key Research Areas to enhance its ability to contribute to government policy objectives and capitalise on opportunities within Australia and the Asia Pacific Region.

The Review recommended that steps be taken to transfer the management of ANSTO's Biomedicine and Health Program and the National Medical Cyclotron to an organisation or organisations within the health and medical community, and that mechanisms be sought for spinning off the commercial activities of Australian Radioisotopes. The further consideration of these recommendations will require interdepartmental discussion and involvement of a range of stakeholders.

Other recommendations included the need to reconsider the external revenue target for ANSTO and the establishment of a Nuclear Science Policy Committee to provide advice and guidance to the Board with regard to aligning ANSTO's scientific activities with Government nuclear policies. The Review also recommended that the effectiveness of Program Advisory Committees (PAC) be enhanced by reviewing current membership, and improving the information received by PAC members.

Consistent with the above objectives, a further recommendation to the ANSTO Board was to generate commitment to a replacement research reactor for HIFAR at the earliest possible date.

Future Actions

The Board considered the recommendations at a number of its meetings since the publication of the Review report.

It has taken steps to re-focus ANSTO's research and technical activity mix to better reflect the Organisation's mission objectives. Certain projects were terminated and negotiations initiated with the view to transferring the lead for some other projects to other organisations. As one of those decisions, the Board decided to cease operation of the smaller 100 kW Moata research reactor at the end of May.

Some of the recommendations, for example, the replacement of HIFAR, the transfer of the Biomedicine and Health Program and the National Medical Cyclotron, and the establishment of a Nuclear Science Policy Committee, were referred to the Minister for an initial response.

Consultation with Program Directors, with the Australian Institute of Nuclear Science and Engineering, and with other interested parties, continued throughout the first half of 1995 and assisted the Board in its responses to the recommendations. The decisions of the Board will be incorporated into a new strategic plan for the Organisation. The budget for the 1995-96 financial year will incorporate some relevant changes brought about by the Mission Review.

The Board is of the firm view that implementation of the recommendations of the Review requiring Ministerial consideration, combined with the actions already taken by the Board and management, will result in a reinvigorated ANSTO directed by a clear mission and focussed on serving the needs of its stakeholders and customers.

Advanced Materials

The Advanced Materials Program is a major centre of materials expertise in Australia, with a multidisciplinary team of motivated ceramists, metallurgists, physicists, chemists, engineers and earth scientists. The Program plays a significant role in maintaining Australia's international profile in the field of nuclear science and technology through the development of Synroc for high-level nuclear waste immobilisation.

Materials assessment technologies are being applied and further developed to ensure the continued safe operation of ANSTO's nuclear plant. These nuclear science and technology skills and infrastructure are being actively exploited in partnership with local industry, CSIRO and universities to contribute to industrial innovation and environmental management in Australia.

The Program discusses with the CSIRO Division of Materials Science and Technology cooperative relationships in research and development in advanced materials to exploit complementary skills and facilities in the national interest. The cooperation was further enhanced in 1994-95 through joint initiatives with CSIRO in the work of the National Council for Materials.

Objectives

- To develop the Synroc process and pursue its commercialisation in conjunction with appropriate partners at national and international levels.

- To maintain a core capability in materials science and engineering to ensure the safe operation of ANSTO's nuclear facilities and to advance Australia's broader interests in nuclear science and technology.

- To enhance Australia's industrial competitiveness through application of our core skills and facilities to local industry by further development of:

- the testing and characterisation of materials to improve techniques for the remaining life assessment of industrial plant;
- improved processing routes for the manufacture of specialised ceramics; and
- cost effective surface engineering technologies.

Outcomes

The Program has:

- strengthened its scientific and commercial linkages to further develop Synroc. Research contracts funded by the US Department of Energy have been successfully completed on High Level Waste (HLW) remediation with Pacific Northwest Laboratories, Hanford, USA. Discussions have been initiated with nuclear architect/engineering companies active in the remediation of US defence wastes. The ANSTO Board approved an operational plan for the Synroc Project for 1995-1998, following the development of a strategic plan for the next 10 years in association with domestic and international consultants;

- completed a joint study with Lawrence Livermore National Laboratory (LLNL) in the USA on the potential application of Synroc for dealing with excess weapons plutonium. The results of that study formed the basis of a Programmatic Environmental Impact Statement that established Synroc as a leading contender for the plutonium immobilisation option in the USA;

- begun a new collaborative research program on Synroc with S.I.A. Radon, Moscow, Russia, following a letter of intent signed with Minatom on cooperation in nuclear science and technology, including evaluation of Synroc as a waste form for HLW in Russia;

- successfully completed the development and testing of cements for conditioning the low level radioactive wastes stored by Australian Defence Industries (ADI) at St Marys, NSW prior to their transport to Woomera, SA;

- successfully completed a project on the development of process methods for application of sol-gel coatings on graphite and metallic substrates in collaboration with Silicon Technologies Australia Ltd, Comalco Ltd, Monash University, University of Technology, Sydney, AWA-Defence Industries and Materials Research Laboratory, Defence Science and Technology Organisation with support from the Energy Research and Development Corporation (ERDC). Dense, crack-free alumina coatings up to 10 μm thick were achieved by a single dip process;

- commenced an ERDC supported project with M.E.T.T.S. Ltd, AGL Gas Company (NSW), Ltd, and the University of Sydney to develop ceramics with controlled porosity, suitable for application to radiant tube technology, to maximise power density and efficiency in high temperature boiler systems;

- completed an extensive investigation of the mechanical properties and thermal shock resistance of carbon anodes for an Australian aluminium smelter. Plant tests of subsequently modified anodes demonstrated a significant reduction in cracking;

- gained a prestigious New Energy Industrial Development Organisation (NEDO) grant from Japan to study the surface properties of zirconia in collaboration with Japanese industry and universities in Japan, Holland, Germany and the USA to develop zirconia ceramics with enhanced oxygen conduction;

- completed the European BRITE/EURAM project on 'Interface segregation in oxide ceramic materials and its effect on processing and properties' in collaboration with universities in France, Germany and the UK.

Activities and Outputs

Waste Conditioning

The Program is responsible for research and development of improved conditioning technologies for both high and low level radioactive wastes. This work is linked to activities in the Environmental Science Program focused on the migration of radionuclides in the far field regions of repository environments.

Synroc

The development of Synroc is linked with key organisations involved in HLW management in all countries pursuing commercial reprocessing of spent fuel. These research links allow ANSTO access to facilities that do not exist in Australia, thereby enabling the accelerated testing of the resistance of Synroc to damage from alpha decay of long-lived radionuclides. In addition, the results of joint research provide an independent confirmation of Synroc as an advanced second generation wasteform. The



Gerry Irfani screenprinting electrodes onto ceramic tape for use in multilayer capacitors in medical devices.

cooperative research also addresses advanced concepts of HLW management involving separation of fission products from the long-lived actinides, allowing Synroc to be utilised in parallel with the established glass wasteforms.

Accelerated alpha-damage tests utilising curium-244 at Japan Atomic Energy Research Institute (JAERI) proceeded on schedule. Synroc-C specimens continued to exhibit resistance to micro-cracking and useful results emerged from the early stages of tests on single phase perovskite and zirconolite specimens. These tests supported earlier observations that perovskite specimens incurred a larger volume change per unit of alpha dose than zirconolite. The accelerated alpha-damage tests at JAERI were complemented by studies at ANSTO of radiation damage effects and geochemical alterations of natural zirconolite and perovskite specimens that have survived more severe conditions in geological environments than could be envisaged in a HLW repository.

The inherent durability of Synroc in water has created difficulties in obtaining experimental data to test possible mechanisms of its aqueous dissolution. Program staff have developed a promising method, based on elastic recoil detection using ANSTO's Van de Graaff accelerator, for studying Synroc reactions with deuterated water at 120°C and 190°C. This technique increased the sensitivity for detection of aqueous penetration in the surface regions of Synroc compared with more conventional measurements using normal water.

Research on microstructural and solid state chemistry aspects of Synroc were greatly assisted by access to the unique facilities of the Australian National Beamline Facility at the Photon Factory, Tsukuba, Japan.

The Program demonstrated that up to 40% by weight of technetium dioxide can be incorporated in solid solution in

perovskite. This complements earlier studies that have shown that technetium resides in the metallic phases in Synroc-C. The ability to influence the host phase for various waste components through process control provides Synroc with the flexibility to cope with unusual waste streams associated with past defence projects in the USA.

The volume of HLW associated with Hanford Tank Wastes requires a process with a much higher production rate than can be met by ceramic process technologies such as those developed for Synroc-C. A new formulation was developed that can be melted to yield a glass/Synroc composite with waste loadings as high as 70%. The resultant product contains the well characterised crystalline zirconolite and perovskite phases as hosts for the long-lived components of Hanford wastes. The glass component is an alumino-silicate with greater durability than borosilicate glass.

Synroc process development included scoping studies of the use of microwaves to facilitate the incorporation of simulated HLW solutions into Synroc microsphere precursors. The final report was submitted to the Australian Energy Research and Development Corporation (ERDC) on Synroc microsphere production. Microsphere precursors for high-zirconolite ceramics for the immobilisation of excess weapons plutonium were developed and impregnated with inactive simulants of plutonium.

Program staff participated in the International Atomic Energy Agency (IAEA) Coordinated Research Program on 'Performance of High-Level Waste Forms and Packages under Repository Conditions' and in an information exchange program on actinide and fission product partitioning and transmutation sponsored by the OECD Nuclear Energy Agency. ANSTO also participates in the work of the International Atomic Energy Agency

(IAEA) through membership of the International Waste Advisory Committee, which is responsible for guiding the development of Standards and Safety Guides for radioactive waste management through its Radioactive Waste Safety Standards (RADWASS) program. The Advanced Materials Program played a pivotal role in developing ANSTO's submission to the Senate Select Committee on the Dangers of Radioactive Waste.

Cement Waste Forms

Cements are widely used for the encapsulation of low-level radioactive waste.

Program staff continued developing and testing cement formulations for ANSTO's wastes and successfully participated in the encapsulation of ADI wastes at St Marys, NSW, to enable their safe transport to Woomera, SA.

This work was supported by more fundamental research on the microstructure of cement paste, carried out in collaboration with the USA's National Science Foundation Center for Science and Technology of Advanced Cement-Based Materials. Studies on the immobilisation of zeolites in cement, in collaboration with the University of Technology, Sydney and the University of New South Wales, demonstrated that a local zeolite could be utilised in the treatment of low level radioactive liquid waste.

Stabilisation and Processing of Radioactive Minerals

This project, carried out in cooperation with the Environmental Science Program, aims at transferring the technology and expertise associated with the Synroc project to industrial problems. Industry funded projects have focused on the stabilisation of wastes containing low levels of naturally occurring radioactivity and the identification and measurement of low levels of radioactive contaminants in feedstocks for the electronics industry.

ANSTO's expertise and facilities in determining the immobilisation of radioactive materials will be used to investigate whether the methods being used to rehabilitate the Maralinga test site are successful in preventing the release of long-term radioactivity to the environment.

Advanced Ceramics

ANSTO has developed unique facilities and expertise in selected areas of advanced ceramics as part of the Synroc project. These skills and unique facilities have been utilised by local industry under a variety of technology transfer mechanisms. Teams are formed with universities and CSIRO to harness complementary skills for the benefit of industry.

Functional Ceramics

Much of the work on functional ceramics is based on sol-gel science and technology originally developed at ANSTO to provide improved routes for Synroc precursor production. The technology has since been adapted to non-nuclear applications, providing innovative solutions for functional ceramics, such as corrosion and abrasion resistant coatings on metals, ceramics, graphite and refractories, or thick and thin films in dielectric, piezoelectric, photochromic and sensor applications.

ANSTO is participating with CSIRO in collaborative research on ceramics and refractories under the Australia/China Joint Science and Technology Commission umbrella, with support from the Commonwealth Department of Industry, Science and Technology. One project is focused on monolithic sol-gel mullite and nanocomposites with good thermal shock resistance.

Sol-Gel Science and Technology

Synroc oriented sol-gel studies focused in the following areas:

- the development of titanate ion-exchangers and ion selective absorption

media with controlled nanoporosity, suitable for the selective sorption of radioactive and other waste elements. These activities have been supported by fundamental studies of structure, control of the nanopore size by templating, and ion exchange capacity;

- the sorption of waste products from ANSTO's radioisotope processing using titania/zirconia ion exchange gels to develop improved methods of waste solidification;

- the *in situ* denitration of wastes by titanate gels.

ANSTO has an active collaborative program on basic studies of concentrated titanate sols with the Commissariat à l'Énergie Atomique (CEA), Saclay, France. Insights into the processes occurring at the particle/solution interfaces during nucleation and growth in colloidal systems, and the ultrastructure of sols, are being provided by small angle x-ray and neutron scattering studies.

Strategic studies in sol-gel sciences continued, in collaboration with universities, on the formation of oxide nanoparticles in reverse micelles, hydrolysis of alkoxides, crystallisation of zirconia gels and films, photo-chemistry of porous titanate sol-gel films and the role of anions in sol-gel processing of titania. These joint projects involved the University of Auckland, Monash University, Queensland University of Technology, University of New South Wales and University of Technology, Sydney.

High Temperature Fabrication

The primary aim of this project is to exploit the facilities and ceramic processing skills associated with the Synroc Project through technology transfer via industry funded projects. Continued assistance has been given to a local company to commercialise silicon carbide components.

An industry driven project to investigate the mechanical properties and thermal shock resistance of carbon anodes in aluminium smelting has been extended to industrial trials. On the basis of ANSTO's understanding of the factors promoting cracking, a batch of modified anodes was produced by the company. Plant scale trials demonstrated a significantly reduced cracking rate in the modified anodes, and larger scale industrial trials are planned.

Strategic basic research on high temperature processing of ceramics has been conducted in cooperation with universities under the AINSE umbrella.

The second stage of the project on high performance silicon nitride under the Australia/China Joint Science and Technology Commission Program has been initiated with the application of hot isostatic pressing to materials processed in China.

Materials Assessment

ANSTO is applying existing, and developing improved, techniques of materials assessment as part of the overall program on the structural integrity and remaining life assessment of research reactor components.

The structural integrity of the HIFAR reactor aluminium tank (RAT) was assessed using data on the effects of radiation on aluminium alloys. The assessment was based on both generic information obtained from similar reactors overseas and specific data resulting from the current project on the assessment of materials removed from HIFAR. The mechanical testing and microscopic analysis of these materials has confirmed confidence in the RAT primary containment. A computer-based structural integrity assessment code was installed and is used to assess the effect of a range of postulated defects and loading conditions on the integrity of the RAT. The techniques planned for the

inspection of the RAT in 1995 have been included in an IAEA linked coordinated research program which will bring together research reactor inspection experience from around the world.

A strategic acoustic imaging project continues to be pursued to extract as much information as possible from the data collected during the ultrasonic inspection of the HIFAR RAT. Improvements to the image reconstruction algorithms are expected to enhance defect detection and characterisation capabilities.

A collaborative research program with Pacific Power continued, with the aim of further developing ANSTO's expertise and skills to enable effective support to the electricity generating industry. An Australian Electricity Supply Industry Research Board funded project on the remaining life estimation of turbine rotors entered its second year. Three power rotors from utilities in Queensland, Victoria and New Zealand have been extensively investigated using metallurgical techniques. The Program also continued participation in an Australian Research Council (ARC) funded project with the UNSW. The project aim is to develop advanced maintenance forecasting and remaining life assessment techniques for boiler tubing.

The Materials Assessment team continued its active role in the Cooperative Research Centre for Materials Welding and Joining, being involved in projects on the welding of thermally modified structures and the determination of defect acceptance levels in girth welds in thin walled pipeline. These projects involved partners in BHP, the University of Wollongong, CSIRO and the Welding Technology Institute of Australia.

Collaboration with BHP and the University of Wollongong in a CRC project on cold cracking in welds continued, with the thermal, hydrogen diffusion and stress analysis aspects of the project being performed at ANSTO.

Surface Engineering

International interest increased in ANSTO's work in Plasma Immersion Ion Implantation (PI³) as a new technique for improving wear resistance and overall service life of tool materials and components. A PI³ system was sold to the Technical University of Clausthal in Germany and was successfully commissioned after delivery. Collaboration with this University over the year saw the PI³ process applied to a wider range of materials and components. ANSTO also supplied a PI³ power supply to the Australian National University for their investigations of plasma ion implantation into semiconductor materials. Collaborative studies with the University of Wollongong and the University of Birmingham have resulted in significant advances in the understanding of the PI³ process and its application to austenitic stainless steel, low alloy steels and titanium alloys.

In February 1995, ANSTO hosted the Second International Workshop on Plasma-Based Ion Implantation with participants from 12 countries. The workshop was very successful and highlighted ANSTO's pre-eminent position in the field, particularly in system development and hybrid implantation/diffusion treatments.

Strategic studies on the mechanisms of nitriding using low pressure plasmas continued in collaboration with the University of New England through an Australian Research Council grant, providing important new insights into aspects of the PI³ process. Members of the plasma group are also involved in a project at the University of Wollongong

on the use of microwave plasmas for ceramic-metal joining as part of the CRC for Materials Welding and Joining.

The Mission Review of ANSTO by international consultants identified plasma surface engineering as an activity outside the proposed key research areas for ANSTO and recommended transfer to another organisation. Preliminary investigations have not yet identified an appropriate means of accomplishing such a transfer. Discussions are continuing with industry and effort will be focussed on developing the PI³ process towards commercialisation.

Basic strategic research into the behaviour of ceramic interfaces is undertaken to derive a better understanding of surface and interface effects in Synroc. ANSTO's unique range of skills and facilities are used to study both model systems and materials of interest to industry.

An apparatus for the measurements of the electrical conductivity and thermopower (Seebeck effect) at elevated temperatures was constructed and commissioned to study semiconducting properties of oxide ceramic materials in equilibrium with the gas phase. These measurements, along with the measurements of work function, allow the determination of the effect of segregation on properties of the materials. A major strategic project on interface segregation in oxide ceramic materials under the European BRITE/EURAM program in collaboration with universities in France, Germany and the United Kingdom was completed.

Applied research was carried out on the mullite/zirconia composite as a new oxygen conductor for construction of high temperature gas sensors. This study was performed in collaboration with the Industrial Research Institute of Ishikawa at Kanazawa, Japan.

A new strategic research program on surface properties of zirconia and its solid solutions was initiated in collaboration with the Tokyo Institute of Technology and Fuji Electric in Japan, the University of Eindhoven in The Netherlands, the University of Kiel in Germany and the University of Hawaii in the USA. The project is supported by the Japanese Government through the NEDO Fund. The project aims to understand mechanisms that could lead to the development of improved oxygen conduction in zirconia for applications in gas sensors and fuel cells.

Research has been initiated on the surface properties of electrode materials for solid oxide fuel cells. This project is supported by Ceramic Oxide Fuel Cells Ltd.

Applications of Nuclear Physics

The Applications of Nuclear Physics Program carries out strategic and collaborative research. It provides support to other ANSTO Programs, Australian universities via the Australian Institute of Nuclear Science and Engineering (AINSE), CSIRO Divisions and Australian industry, including small business. Many of the projects are multi-disciplinary, where the skills of specialists in specific areas are assisted by the Program's nuclear physics-based measurement skills and analytical capabilities. The Program also has a large international collaborative research effort.

Objectives

- Development and promotion of research programs on national nuclear science facilities such as charged particle accelerators and neutron beam instruments, encouraging strategic research in nuclear science and technology at ANSTO, in tertiary institutions and industrial research and development laboratories.
- Participation in and management of Australian use of international facilities for neutron scattering, synchrotron radiation and high energy physics to assist graduate training in the universities and to foster Australian benefits from developments in high technology.
- Expansion of the use of the Accelerator Mass Spectrometry (AMS) service, both nationally and internationally, to make major contributions in the understanding

and remediation of severe environmental problems, such as the greenhouse effect.

- Application of charged particle beams and ionising radiation to industrial, biological and environmental problems.
- Exploitation of neutron scattering techniques in the development of new materials, drugs, biological substances and complex chemicals.
- Maintenance of expertise in fundamental nuclear and atomic processes, including neutron physics, ion interactions, radiation standards, dosimetry and laser enrichment.

Outcomes

- A report on the Aerosol Sampling Project was submitted to the Energy Research and Development Corporation. The massive database obtained from a two year, 24-site monitoring program provided new information on the distribution, composition and sources of fine particle aerosols in the major urban areas of NSW. This will assist Government and local authorities to establish guidelines for protecting community health and living standards.
- The performance of the Australian National Tandem Accelerator for Applied Research (ANTARES) for AMS applications has been improved significantly with the installation of a multi-sample high intensity ion source. As a consequence, demand for time on the accelerator by the Australian research community and groups in Italy, France, UK and Japan



David Garton checking an ANSTO aerosol sampling monitor at Sydney's Kingsford Smith Airport, one of a chain of monitors in major urban areas of New South Wales.

increased significantly. It has also been demonstrated experimentally that the AMS capability can contribute to improved International Atomic Energy Agency monitoring in support of the Nuclear Non Proliferation Treaty and a potential Comprehensive Test Ban Treaty.

- A high level of interaction with the Australian academic community continued, with 138 collaborative projects in progress with Australian universities staff. More than 100 post-graduate students were dependent upon these interactive programs for their higher degrees.

- Neutron diffraction has been used to determine the phase composition in advanced engineering ceramics and the results obtained are impacting on the production of established ceramics and on the development of new ones. Neutrons have also been used to examine the residual stresses within welded steel.

- The Australian National Beamline Facility (ANBF) at Tsukuba in Japan is now operational, with its performance for powder diffraction ranking with that of the best in the world. It has already been used to study high temperature superconductors, ceramics, Synroc constituents, metal hydrides and cement.

Activities and Outputs

Accelerator Based Ion Beam Analysis

The ion beam analytical facilities on ANTARES have been enhanced by further development of the heavy ion time-of-flight recoil spectrometer. This instrument enabled several successful investigations to be performed, most notably studies on the characterisation of modified high temperature superconductors and semiconductor ohmic contacts. Its powerful diagnostic capabilities attracted interest from

Australian scientists and from researchers in Sweden, Germany and the USA. The demand for ion beam analysis on the 3MV Van de Graaff accelerator by staff at AINSE member universities remained at a high level, particularly in the fields of materials, surface science, geology and archaeology and fine particle aerosol analysis.

Accelerator Mass Spectrometry

The AMS team has established a centre for the ultrasensitive analysis of radiocarbon and other long-lived radioisotopes. The research program involves a multi-disciplinary and multi-institutional effort aimed at studying environmental and public health issues concerning the international community such as global climate change, environmental pollution and nuclear safeguards. Studies in Quaternary science and biomedicine based on AMS analyses of long-lived radioisotopes are also carried out. These programs are based on cooperation with universities, research institutions and government agencies both in Australia and overseas.

Measurement procedures were developed for the following radioisotopes: carbon-14, aluminium-26, beryllium-10, chlorine-36 and iodine-129.

The recently installed multiple-sample source is working with high performance and reliability. More than 500 unknown samples were analysed during the year, mostly for the Quaternary science program funded by AINSE and the Australian Research Council. A precision of less than 0.5% in the carbon-14 to carbon-12 ratio has been obtained for many measurements of near-modern samples. Upgrading of the high-energy beam transport system and installation of a gas stripper is planned for the coming year to achieve a routine accuracy of better than 0.5%, which is needed for the analysis of carbon-14 in sea waters, tree rings and ice cores for climatic studies.

The chemistry laboratory for processing radiocarbon samples includes hydrolysis, oxidation and graphitisation lines which allow the preparation of 8 AMS samples per day. The chemistry background corresponds to an isotopic ratio carbon-14/carbon-12 of 1×10^{-15} and 3×10^{-15} for the hydrolysis and combustion processes. Thus, unknown samples older than 50 000 years can be analysed.

A national program on Quaternary science based on AMS analysis of long-lived radioisotopes is in progress in collaboration with 31 Australian universities. Examples of the diversity of the projects is illustrated by: high resolution study of historical atmospheric carbon-14 variations from analyses of individual tree rings of Tasmanian Huon pine (with University of Sydney and CSIRO Division of Atmospheric Research); dating of prehistoric aboriginal rock paintings (with James Cook University and University of Queensland); dating stick nest rat middens from inland Australia (with University of NSW and University of Wollongong); Cape York archaeological project (with University of Queensland); AMS for dating of mineralisation in the secondary zone of the Broken Hill orebody (with University of Melbourne); glacial history of the northern Prince Charles Mountains region, Antarctica, using *in situ* produced beryllium-10 and aluminium-26 to model rock surface exposure history (with University of New England); and determination of growth rates of tropical trees by carbon-14 measurements using a standard based on Java teak (with Monash University).

The first samples from Antarctic ice and firn were analysed for the joint project on Antarctic ice cores, funded by the National Greenhouse Advisory Committee (NGAC), with CSIRO, the Cooperative Research Centre for Antarctic Studies and the Australian National University. These carbon dioxide samples have been processed at the CSIRO Division of Atmospheric Sciences, Melbourne. The first results are consistent with the air

diffusion model developed by the CSIRO Division of Atmospheric Sciences. For the second NGAC project, in collaboration with CSIRO and Flinders University, a chemistry laboratory to process sea water samples has been constructed at the CSIRO Division of Oceanography in Hobart, following procedures developed at Woods Hole Oceanographic Institute, USA. Concentrations of carbon-14 in the first oceanographic samples were recently measured and will provide boundary conditions - flow of waters from the north into the Southern Ocean - for the oceanographic model developed at Flinders University.

International collaborative projects include studies of long lived radioisotopes in natural analogues with the University of Paris-Sud and the University of Turin; radiocarbon samples associated with the remains of the 5 200 years old Iceman, which may assist understanding of the development of the Bronze Age in central Europe, with the University of Innsbruck, Austria; and, precision dating of the glue used by the 15th-century sculptor Donatello to repair his statue broken in the kiln, with the Italian Ministry of Cultural Heritage.

Neutron Scattering

The neutron scattering facilities based on the neutron beams from HIFAR continued to be exploited by Program staff, working in collaboration with more than 30 groups from Australian universities. Coordination was provided by AINSE.

There was further progress on the upgrading of neutron scattering instrumentation, with considerable effort given to installation of a new diffractometer for studies of single crystal specimens. Although the commissioning of this diffractometer is not complete, it has already provided high quality data on the complex crystal structure of a bismuth-based high temperature superconductor. The work on the development of the Australian Small Angle Neutron Scattering

instrument (AUSANS) continued, but there was delay in the construction and testing of the position-sensitive detector to be used on this instrument. Funds were obtained from the Australian Research Council (ARC) by AINSE to upgrade the high resolution powder diffractometer, a development which will further enhance Australia's already very significant capability to study samples obtained in powdered (polycrystalline) form. The medium resolution powder diffractometer was used successfully in several *in situ* studies of the devitrification of glasses. Progress was made on a longer term plan, also funded by ARC, to upgrade the performance of the polarisation analysis instrument.

Other highlights of the neutron scattering research included the completion of systematic studies of metal dioxides with the rutile crystal structure, and of a number of measurements on oxides which occur as pyrochlores. Such systematic studies provide detailed information on the nature of the chemical bonding in these materials.

In continuing research on metal hydrides (or deuterides), the room temperature crystal structure of a zirconium-nickel deuteride was solved, as was the structure that this compound adopts at low temperature. The polarisation analysis instrument was used to investigate the magnetic domain structure in ribbons of an iron-zirconium alloy, these being related to magnetic recording tapes. In several instances, the neutron data was supplemented by X-ray data obtained using the diffractometer installed at the Australian National Beamline Facility (ANBF), Tsukuba Science City, Japan.

Synchrotron Radiation

ANSTO is the principal partner in the consortium funding the Australian National Beamline Facility, currently the only Australian synchrotron radiation beamline. The ANBF is a multi-purpose

X-ray beamline. It is operated by ANSTO as an Australian national facility. In 1994-95 a total of 30 projects were performed by Australian research groups from universities, government laboratories (ANSTO, CSIRO and Aeronautical and Maritime Research Laboratories) and industry (Telstra).

Recent milestones included the first use of the ANBF for grazing incidence X-ray diffraction, the installation and successful testing of a focusing monochromator and the funding of a major new detector for XAFS measurements.

High Energy Physics

ANSTO, in collaboration with particle physics groups from the Universities of Melbourne and Sydney, has been participating in two major experiments at the European Laboratory for Particle Physics (CERN), near Geneva. The experiments, named NOMAD and ATLAS, are large international collaborations and involve about 140 and 1 500 physicists respectively.

NOMAD involves a search for evidence that the fundamental particles called neutrinos possess mass. This is one of the key issues in particle physics. Furthermore, if neutrinos have mass, they will have had significant impact on the evolution of the universe. As well as participating in the operation of the experiment and the development of software for data analysis, ANSTO scientists contributed to an extension of the experiment's capabilities with the design and implementation of an additional component in the forward region of the detector.

ATLAS is a detector that is being developed for use with the Large Hadron Collider (LHC), construction of which was approved by the CERN Council in December 1994. The LHC and its detectors will be the premier particle physics facility in the first decades of the 21st century. Its main purpose is to search for the Higgs boson, detection of

which is crucial to the understanding of the processes that determine why fundamental particles have their observed masses. ANSTO scientists are participating in the development of a new generation of particle detectors based on the semiconductor material, gallium arsenide.

Other International Interaction

Involvement with the Rutherford Appleton Laboratory, UK, has allowed continued access for Australian scientists to the ISIS spallation neutron source. Financial contributions from ANSTO assisted with the construction of an improved surface reflectometer. An attached ANSTO scientist has assisted in the commissioning stage. Interaction with the IAEA continued at a high level with direct involvement and management of a number of IAEA sponsored courses and specialist contributions to IAEA Advisory Committees.

Publications

In 1994-95, 126 papers were prepared, of which 86 were accepted in international journals and international conferences, contributing significantly to the understanding of research issues associated with ANSTO's core activities. Several staff presented invited review papers at these international conferences, verifying the quality of the work and the stature of the staff.

Environmental Science

The Environmental Science Program was initially formed because of the need for research to measure, evaluate, predict and monitor the environmental impacts associated with uranium mining and processing in Australia, the operation of the reactors at Lucas Heights and the safe treatment and disposal of radioactive wastes. These activities remain the core function of the Program.

The multidisciplinary team of biologists, microbiologists, chemists, engineers, geologists, geochemists, physicists and applied mathematicians also contribute their special expertise in nuclear science-based techniques to the solution of broader environmental problems of current concern, both nationally and internationally.

Objectives

The objective of the Program is to carry out a *problem-focused, balanced* program of strategic and applied research and development, using its nuclear science-based core expertise and closely-related techniques, to:

- assist the Commonwealth Government to further its international initiatives, meet treaty obligations and respond appropriately on technical and policy issues requiring authoritative environmental advice;
- assist governments, their agencies, private institutions and companies to protect, improve and conserve the natural environment within the context of sustainable development;

- assist Australian industry in advancing Australia's competitive position in the world economy; and

- ensure that environmental monitoring of activities associated with nuclear facilities at the Lucas Heights Research Laboratories is both consistent with international best practice and effective in assuring operational adherence to sound environmental protection principles.

Outcomes

- **Geochemistry and Pollutant Transport:** Program scientists completed development and testing of a computer code, known as CEQUIL, for modelling the geochemical processes that can pollute groundwaters in the vicinity of a mine when it is closed and allowed to flood. This code, together with other ANSTO codes that describe ground water movement, was successfully demonstrated at the 13 billion DM rehabilitation program of the WISMUT GmbH uranium minesites in eastern Germany. It was used there to establish the geochemical processes and their impacts on ground water that will arise from flooding of the mines at Ronneburg and Königstein. These former uranium mines are closed and are being rehabilitated by the mine owner, WISMUT GmbH. The Ronneburg site allowed an important practical testing of a kinetic component of the code which had not been used before. Similarly, the Königstein site allowed validation of code characteristics against a large scale flooding experiment. Both sites provided

important experience in practical testing and application of the codes. This experience will be applied to Australian situations in the coming year. CEQUIL is being incorporated into the ENTEC environmental software package of the Australian software house, SURPAC Software International, which successfully markets its product worldwide.

• **Australian Centre for Minesite Rehabilitation Research:**

During the year, the Program became a full partner in the Australian Centre for Minesite Rehabilitation Research (ACMRR), with responsibility for developing and managing a collaborative research program on acid mine drainage, which has been identified by the Australian mining industry as a major future environmental liability. The ACMRR, comprising the University of Queensland, Curtin University, the University of Western Australia, the Australian Mineral Industries Research Association Limited, CSIRO and ANSTO, brings together the best scientific expertise in Australia to tackle the fundamental research needs associated with minesite rehabilitation problems. This Centre is unique in the world and is already emerging as an effective vehicle for exporting innovative Australian minesite rehabilitation knowhow and technology.

• **Arsenic Waste Treatment:**

Arsenic is often found in copper, gold, lead, nickel and some uranium ores. Already, the supply of arsenic far exceeds the world demand. The disposal problem of the excess arsenic will worsen as high grade ores are exhausted and ores with higher arsenic content are increasingly being processed. A research team of scientists developed and demonstrated a laboratory scale innovative technology for treating and immobilising arsenic wastes. The three year research program, carried out at ANSTO under the umbrella of the Cooperative Research Centre for Waste Management and Pollution Control

Limited, has resulted in the discovery of processes (patent pending) for photo-assisted oxidation and immobilisation of arsenic.

The United States Environmental Protection Agency has shown a strong interest in the process and is funding a \$A1 million demonstration project to treat wastes from a smelter in Montana. Both low pressure mercury lamps and sunlight will be used during the demonstration. Using another process developed at ANSTO, the oxidised arsenic will be stabilised in an insoluble form which passes the US Environmental Protection Agency's standard leach test for landfill disposal and therefore is suitable for safe storage or disposal. ANSTO is collaborating with a United States company, Mountain State Energy, Inc. of Butte, Montana, for the demonstration project which will be carried out in 1996.

This technology is also applicable to the treatment of arsenic-rich flue dust from Australian smelters and ANSTO is currently working with several Australian mining companies to help solve their arsenic disposal problems.

Activities and Outputs

Environmental Impact of Mining

Laboratory testing was carried out on behalf of the Mt Isa Mines/Savage Resources Partnership to establish the environmental behaviour of the major rock types found at the Ernest Henry project in Queensland. Long term column leaching studies were conducted under conditions closely mimicking the natural environment. The results obtained are contributing to the baseline environmental data required by the Partnership to establish the inherent environmental safety of the development.

ANSTO used remote sensing as an environmental monitoring tool to complement ground-based pollutant transport and dispersion measurements. The method is a non-invasive technique for establishing environmental impact and environmental stress arising from natural and man-made events. Aerial photography was used to quantify the vegetation patterns down-stream of the abandoned uranium mine at Rum Jungle. Photographs dating back to 1941 were used to assess the pre-mining vegetation, the impact of the mine and subsequent rehabilitation on the Finniss River. A similar program was carried out in the vicinity of the Ranger tailings dam. This work was carried out in collaboration with the University of Wollongong, the Department of Mines and Energy, Northern Territory, and Energy Resources of Australia.

Acid Mine Drainage

The oxidation of sulphide minerals in mine waste rock dumps produces metal sulphates and sulphuric acid. These pollutants can be carried by rainwater infiltrating the dumps, producing drainage which can have a severe environmental impact on surface and ground water resources.

As a result of its high international reputation in the field of acid mine drainage and its experience in the environmental rehabilitation of the Rum Jungle uranium mine, ANSTO was invited by the Brazilian National Nuclear Commission to provide technical advice on decommissioning plans for the uranium mine and milling facilities at Poços de Caldas, about 200 km north-west of Rio de Janeiro. A scientist travelled to Brazil in May for a two-week consultancy with the Institute of Radiation Protection and Dosimetry and the mine environmental managers. A proposal was made by ANSTO to undertake further research work which will promote the links between the organisations. Site studies, scientific

research consultancy and technology transfer were proposed for development of a site remediation strategy.

As well as continuing sponsored research for the Australian metal mining industry, significant projects were agreed to for the assessment of the effectiveness of control methods to deal with problems of acid mine drainage from coal reject piles at two mine sites in Queensland's Bowen Basin.

Hydrology

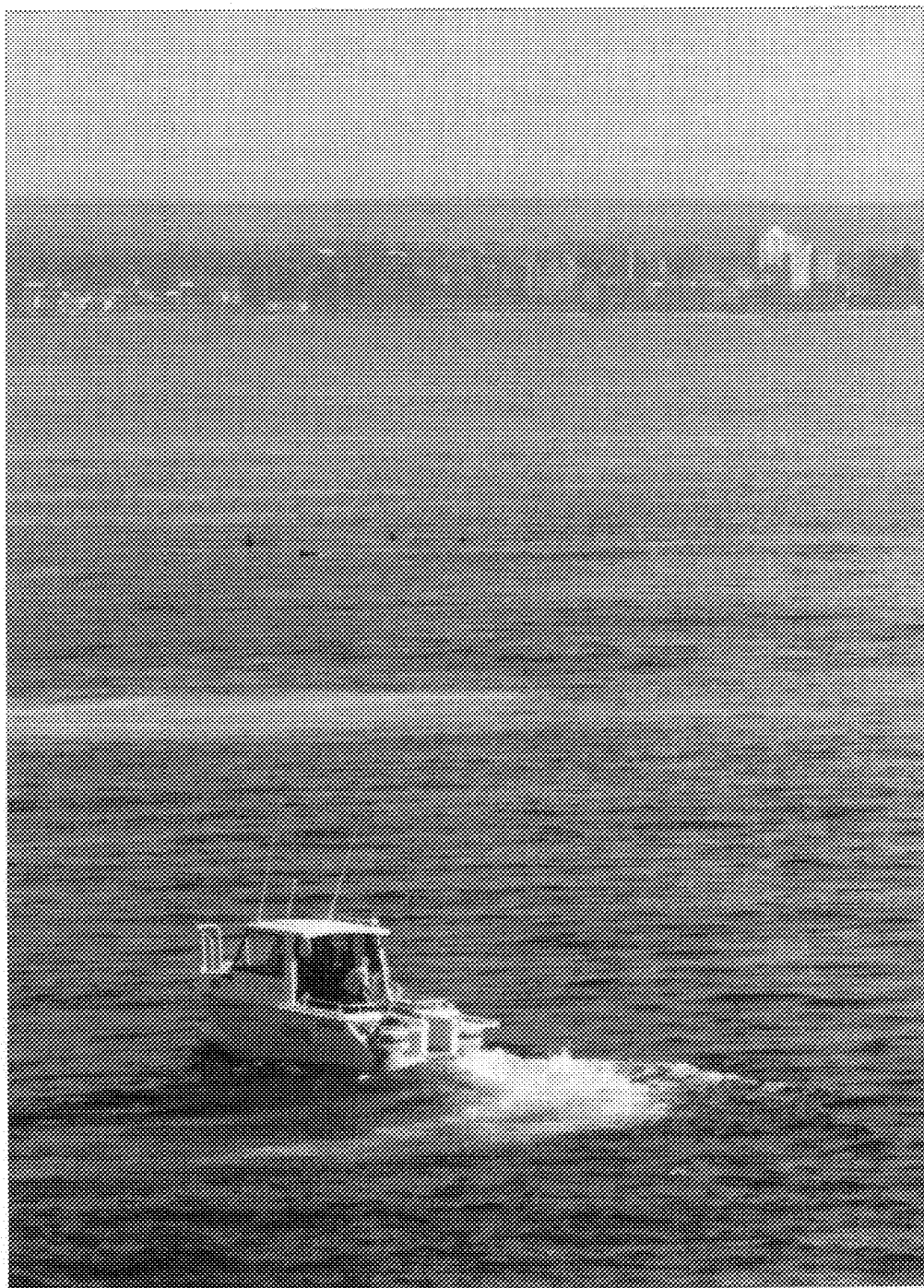
An effective understanding of the patterns of water flow through landforms is crucial to the safeguarding of water resources from pollutants. Waste rock dumps at mine sites can be major sources of such pollutants. A good model of water flow through unsaturated waste rock dumps is needed to be able to predict the environmental impact of these entities on the water resources but current models have been found to be inadequate.

ANSTO has commenced a program of sponsored research for Energy Resources Australia at the Ranger uranium mine in the Northern Territory to address the issue of the hydrology of waste rock dumps. A dump was instrumented with lysimeters and time domain reflectometry probes at a range of depths to provide data on moisture distribution and water flow paths within the waste rock during the wet and dry seasons. Data from the project are being used in ANSTO's project to develop a suitable mathematical model of water flow patterns in unsaturated systems.

Environmental Applications of Radioisotopes

Radon

Naturally-occurring radioactive radon gas is used to trace continental-scale air movement. Global climate models can be tested by comparing measured radon concentrations with levels predicted by the models.



The ANSTO survey vessel *Imara* collecting seawater samples off Potter Point, Cronulla, New South Wales, as part of an ANSTO environmental monitoring program.

ANSTO is collaborating with the State University of New York and the New Mexico Institute of Mining and Technology (NMIMT) to improve knowledge of the global radon source. As part of this collaboration, and to maintain its lead in radon flux measurement techniques, ANSTO participated in an inter-laboratory measurement comparison organised in June by the International Radon Metrology Program of the IAEA.

The decay products of radon, known as radon daughters, mimic many properties of global atmospheric pollutants. This makes radon daughters useful in studying the deposition of pollutants from the atmosphere to the earth's surface and the consequent environmental impact.

ANSTO was invited to collaborate with the Climate Monitoring and Diagnostic Laboratory of the USA and NMIMT in developing two techniques for evaluating the deposition velocity of radon daughters. One technique, applied at the Mauna Loa Observatory, Hawaii, involved measuring the variation in radon daughter concentration with height in the atmosphere. The second technique extended the first by correlating the concentration with wind data measured on a fine scale using extremely fast and accurate instruments.

Ecological Impacts

The major focus of the Ecological Impacts Project is the application of nuclear techniques to the study of the transport of radionuclides and other contaminants through terrestrial and marine ecosystems.

ANSTO's off-shore radiotracer capability was enhanced with the acquisition of the 6 m survey vessel, *Imara*, equipped with state-of-the-art navigation and sampling equipment.

Sewage tracer studies were undertaken at Penang, Malaysia, in collaboration

with the Malaysian Institute of Nuclear Technology Research, and in Hong Kong under contract to Australian Water and Coastal Studies Ltd. ANSTO, through the IAEA, contributed expertise to the Haiphong sand tracing study in Vietnam, the aims of which are to contribute to harbour development.

Work commenced at ANSTO on a clean marine radiochemistry laboratory which will greatly enhance ANSTO's contribution to major collaborative investigations into marine processes. These include the international Tropical River Ocean Processes in Coastal Settings program, and the Australian Institute of Marine Science/ANSTO Great Australasian Shelf Productivity Study.

Good progress was made on the study of the impact of rehabilitation at the Rum Jungle uranium mine on the biodiversity within the east branch of the Finniss River system. Environmental risk assessment techniques were used to integrate reduction in pollutant releases, improvements in the water chemistry and the return to health of the river catchment. In effect, the east branch of the Finniss is being used as a natural ecotoxicology laboratory.

Research into the dynamics of sedimentation and erosion using the environmental isotope caesium-137 is continuing. An investigation was begun with the Sydney Water Board and the University of Wollongong into the impact of sewage sludge application on soil productivity and erosion at an experimental site near Goulburn. In a joint study implemented through the Australia/China Science and Technology Agreement, attempts will be made during 1995-96 to enhance the value of remote sensing techniques to erosion assessment by correlation with caesium measurements. A major IAEA funded study of the sedimentation around the Inle Lake, Myanmar, was completed.

Use of Natural Radioisotopes In Studies of Climate Change

Radioisotope techniques were used to date fossil coral specimens and fossil turtle bones from Lord Howe Island. This information was valuable in reconstructing the impact of sea-level changes on the island's coral reef during the past 125 000 years. The island's environment is unique, being the world's southernmost living coral reef and a World Heritage area. The studies are part of an ANSTO/University of Wollongong collaboration on dating methods.

Field studies have been carried out on Fraser Island, off Queensland, another World Heritage Area. In close collaboration with the University of Adelaide, ancient lakes on Fraser Island were drilled to sample the lake's organic sediments. By studying the plant remains in these cores, past climate changes can be deduced. A special dating technique, tested and refined by ANSTO, was used to provide these studies with an absolute time-scale.

Naturally-occurring concentrations of radioisotopes from the uranium decay series were used to study the accumulation rates of sediment in the Fly River delta, Papua New Guinea. This work, carried out at ANSTO in close collaboration with the Ocean Sciences Institute of the University of Sydney, aims at understanding the physical processes of sedimentation in this tide-dominated delta. These studies are of importance to further assessment of the potential environmental impact of mining and deforestation in the hinterlands of the Fly River delta.

The appearance of toxic algae in the coastal waters around Hobart is of great environmental concern. Together with the Institute for Antarctic and Southern Ocean Studies, research was carried out to determine the exact year of arrival of these algae. Concentrations of natural

lead and radium isotopes and introduced caesium isotopes were used to date sediment cores from the Huon Estuary in Tasmania.

Environmental Rehabilitation Remediation of Toxic Dredged Sediments

A project, funded by a grant from the Industrial Research and Development Board, on remediation of dredged sediments, is in its final year. The partners in this project are CRA, the Sydney Water Board and Patterson Britton and Partners, consulting marine engineers.

During the year the project focussed on the integration of the various treatment options developed at the beginning of the project. The overall process is a combination of chemical and biochemical extractions, for which flow sheet development and associated cost estimates are being undertaken. Research showed that heavy metals can be effectively removed from contaminated sediments using novel bacteria. Significant reduction in organic contamination was also obtained using mixtures of bacteria. Consideration is now being given to scaling up and commercialising the technology.

Cleaner Production Technology

Uranium Ore Processing

Tailings from uranium mining are generally impounded in a dam designed to high engineering standards so that the waste is contained indefinitely. The cost of tailings disposal at the operating mine is high and additional costs are incurred when mining ceases and the dam must be capped. In some cases, the tailings contain valuable metal values and can be considered as a resource rather than a waste.

ANSTO completed a study to assess the potential for using physical methods to segregate the radionuclides and other unwanted elements from uranium tailings

at the Olympic Dam mine in South Australia. The research demonstrated that the radioactivity was concentrated in the finest particles and that it should be possible to produce a clean, high grade material which could be used as a feed material for steel production.

Polonium is a volatile radioactive element which tends to concentrate in flue dust when ores containing uranium are smelted. A process was developed to remove polonium while, at the same time, recovering uranium and other metals. A continuous mini-plant demonstration of this process is planned at Olympic Dam.

Water Treatment and Reuse

Australian uranium producers are conscious of the need to use process water more efficiently. In some cases, acidic waste water can be treated and reused, resulting in a major saving in make-up water. A small-scale pilot plant was built at Lucas Heights to explore options for treatment and reuse of acidic water. The research aims to maximise recovery of water, produce a dense, easily filterable precipitate and to explore options for recovery of metals as by-products. This research and development is supported by Energy Resources of Australia and Olympic Dam Operations.

Precipitate flotation was studied as a method for simultaneous adsorption removal of contaminants from solution. The contaminants, such as uranium, arsenic or other toxic elements, are first adsorbed on freshly prepared oxide surfaces and then floated by sparging with fine air bubbles. The technique was successfully applied by ANSTO to arsenic contamination but has potential application to many other problems in waste water treatment.

Environmental Monitoring of Lucas Heights

Atmospheric Transport

ANSTO's emergency monitoring system requires models to be available to predict the fate of gaseous releases into the atmosphere in real time.

Atmospheric tracers are used for quantitative measurements of atmospheric dispersion and for validation of computer models which describe these processes.

ANSTO developed a technique which uses perfluorocarbon chemicals as tracers and gas chromatographic techniques to separate and detect them. This method has the advantage that several chemicals can be released simultaneously or sequentially from different locations in order to study the impact of sources of pollutants on downwind receptors.

The method was applied successfully in a consultancy for ALCOA of Australia Ltd in Western Australia to study atmospheric dispersion from a chimney stack. The project was a precursor to employing the technique at the Lucas Heights Research Laboratories to aid in the selection of an atmospheric dispersion model for installation in the site Emergency Response Centre.

Environmental Survey

ANSTO conducts surveys of radioactivity levels in environmental samples in the vicinity of Lucas Heights. Sample types include soil, creek water, stormwater, seawater, vegetation and air. Results are published annually and are publicly available.

In addition to the routine program, environmental monitoring was extended to include the measurement of radioactivity at the Cronulla sewage treatment plant and offshore from the outfall at Potter Point. No significant levels of radioactivity were measured.

Engineering

The Engineering Program is responsible for the design and construction of all new buildings, the maintenance of existing buildings, and the provision and maintenance of electrical, plumbing and other services to them. The Program also has a nuclear, mechanical and electrical engineering design and draughting capability, a maintenance workshop and a Computerised Numerical Control machine tool equipped development workshop. These capabilities and facilities are used for the design and production of specialised research and operational equipment.

Objectives

- To provide cost effective, high quality and timely engineering support to ANSTO's Programs.
- To use ANSTO's unique engineering facilities and capabilities to support Australian industry.

Outcomes

- The design and development of jigs to enable inspections to be made inside the reactor aluminium tank (RAT) during the extended shutdown were completed for the Advanced Materials Program. Six jig designs are required. One will enable cast impressions of the RAT internal surfaces to be obtained while another will enable the surface hardness to be measured. The other four jigs are for holding ultrasonic probes and moving them inside the RAT in the vicinity of the main welds and inside the primary

cooling water pipes. The jigs will be held by a manipulator inserted through appropriate vertical facility holes when the fuel, rigs and heavy water have been removed. Their movements inside the tank will be tracked by video camera.

- The Development Workshop, with assistance from the Advanced Materials Program, developed the processes and successfully manufactured to the required specifications pivot roller bearing assemblies for the Coarse Control Arms (CCA) used to control the nuclear fission rate in HIFAR. The bearing components were manufactured to a tolerance of 2 microns and the Nuclear Safety Bureau approved their use after extensive testing by HIFAR technicians confirmed their reliability. Subsequent use in the reactor has been trouble free and has justified the considerable effort directed towards this project. The bearing assemblies, previously manufactured overseas, were no longer obtainable nor could they be sourced from within Australia.

These outcomes were essential to the continued safe operation of Australia's only research reactor.

Activities and Outputs

Technical Services

During the year Technical Services provided a design and project management service to the Nuclear Technology Program for the replacement of major parts of the HIFAR secondary cooling water circuit. The design work

was approved by the Nuclear Safety Bureau. The tender for manufacture and installation has been let and the work is scheduled for installation during the extended HIFAR maintenance shutdown, due to commence in September 1995.

Engineering staff participated in ANSTO's contract with Australian Defence Industries to condition radioactive waste at St Marys, Sydney. A submission was prepared for the transport of the waste to Woomera, South Australia, in accordance with the Australian Code of Practice for the Safe Transport of Radioactive Substances. The transport operation was completed without incident.

A new centralised monitoring and control system was installed to allow the remote operation of a number of facilities associated with effluent management at Lucas Heights. The heart of the system is a computerised mimic display, which provides on-screen display and control of the various elements of the effluent network, as well as providing automatic control of the plant according to well proven criteria. The system operates only the holding tanks and discharge plant at present, but connection to other effluent plant located around the site is planned.

To ensure the continued reliable and safe operation of the site electrical system, which is up to 35 years old, Engineering began a rolling review and upgrade program. The major work in hand involves an upgrade of switchgear in six of the 12 site substations to modern standards.

Maintenance

Major refurbishing and maintenance work was undertaken for the Environmental Science and Applications of Nuclear Physics Programs. This work involved the stripping out and reconstruction of several laboratories, and included the installation of new

fumehoods which meet the latest standards, recirculated cooling water, gas reticulation and air conditioning systems. Similar refurbishment work was done for Nuclear Technology Program to create a centralised silicon business area and a redesign of the silicon irradiation rig assembly room.

Engineering Maintenance completed preventative and corrective maintenance programs at the Lucas Heights Research Laboratories and the National Medical Cyclotron, Camperdown. Among the major jobs done during the year were the upgrade of Buildings 23 and 35B to meet current fire regulations, the installation of exit signs and the modification of exit doors on numerous buildings to meet current codes, the installation of two new approved cooling towers, the fitting of automatic chemical dosing equipment to five cooling towers, the replacement of roofs on four buildings and the replacement of active exhaust ducting for Building 54.

Maintenance staff supported major capital works projects which included the upgrade of site substations' low voltage switchgear, the replacement of two switchboards in Building 4 and the upgrade of the site water reticulation system to accommodate additional fire hydrants.

Development Workshop

Development of improved processes to manufacture the CCA pivot bearing related parts, including spindles, thrust washers, locating pegs, locking bolts and nuts, was progressed to maintain continuity and reliability of supply to HIFAR.

Other Nuclear Technology projects included a new storage rack for cropped fuel elements in the gamma pond, a spent fuel handling rod and the installation of a walkway on the mezzanine floor level of HIFAR.

All waste management transport flasks were modified progressively to accommodate the use of a standard restraint system to fasten each flask securely to the vehicles to enhance safety.

The Development Workshop manufactured and assisted in the installation of a transfer and weighing rig used for transferring radioactive fission product liquid waste from the B57 storage tanks into a shielded flask for transport to HIFAR hot cells for solidification.

Stainless steel transport containers were required for the safe transport of radioactive waste from St Marys to Woomera. Their manufacture and final welding at St Marys was accomplished with the final product meeting all requirements of a class 1 pressure vessel in accordance with Australian Standard, AS 1210.

The National Medical Cyclotron operation was supported by providing additional mobile and fixed lead shielding, installation of the positron emission tomography transfer vent assembly, manufacture and installation of sliding shields in the autochemistry cells and the progressive deliveries of precision copper irradiation targets plates used in the production of radioisotopes.

Following completion of a new laboratory for the Biomedicine and Health Program, the Development Workshop manufactured and installed new equipment. This included assembling four pairs of hot cells and the lead radiation shielding of fume and laminar flow cabinets.

Quality Control

The Quality Control Section provided annual calibration services for measuring and test equipment used by various Programs on site, notably the length measuring equipment used by Nuclear Technology and Advanced Materials, and

the temperature measuring equipment used by Biomedicine and Health. Measuring and test equipment used by various sections within the Engineering Program was also calibrated.

The Section also provided dimensional inspection services for HIFAR CCA bearings and bearing components to an accuracy of 1 micron.

The inspection of HIFAR internal pipework was commenced following consideration of various inspection techniques. The micro mapping technique, which provides a thickness mapping of the pipework, was adopted.

The regular inspection requirements of Australian Radioisotopes for irradiation cans, radioactive packagings, source holders and associated components were met. Certificates of conformity for the copper targets used by the National Medical Cyclotron were provided on an ongoing basis.

Quality Control inspected and tested new piped gas systems in Buildings 16 and 55 and the new site main for compressed air being installed in Building 4.

During the year a major program was begun to inspect the radioactive waste storage tanks on site. This required determining of the most appropriate inspection techniques to be applied to the various concrete, metal, fibreglass, and glass lined tanks in use.

A significant effort continued in maintaining and building on the quality control system that was established in the Engineering Program to gain accreditation through Standards Australia's Quality Assurance Services (SAQAS) to AS/NZS ISO 9000:1994 Quality System Standards. The Section provided auditors to implement an internal auditing program within Engineering.

During the year a number of initiatives were taken to expand activities in the sphere of calibration. In response to a number of enquiries from commercial clients for calibration of flow meters, a test flow rig was fabricated using orifice plate technology to calibrate flow meters using different mediums of flow. This development has the potential to be of significant benefit to Australian industry. A new capability to calibrate torque measuring equipment was purchased and new equipment was added to improve both the range and the quality of calibration.

Work for Australian industry, leveraging on unique capabilities, included the testing and inspection of products for clients requiring independent quality accreditation. A number of prospective commercial clients, on the recommendation of SAQAS, approached ANSTO to carry out their type testing work. This was a recognition of ANSTO's high quality of work.

Work commenced to design, install and commission a temperature and humidity control system in the metrology laboratory. This will significantly improve the performance of the equipment employed in the Section's calibration activities.

Nuclear Technology

The Program provides a major neutron source as a national irradiation and beam facility using the high flux Australian reactor, HIFAR.

Objectives

- To maintain and operate HIFAR as the major national neutron source.
- To be responsible for the design, installation, operation and maintenance of irradiation and experimental rigs.
- To provide irradiation services for research and commercial activities.
- To provide a waste management service to HIFAR and the Lucas Heights site.
- To maintain and promote knowledge and expertise in nuclear science and engineering.

Outcomes

- A program of work to update the documentation related to the Authorisation - HIFAR Operation was completed in accord with the requirements of the Nuclear Safety Bureau (NSB). As a consequence, the NSB agreed to the continued operation of HIFAR.
- Development of a formal quality system and increased attention to customer satisfaction resulted in record income (\$2.2m) from overseas customers for the irradiation of silicon ingots in HIFAR.

Activities and Outputs

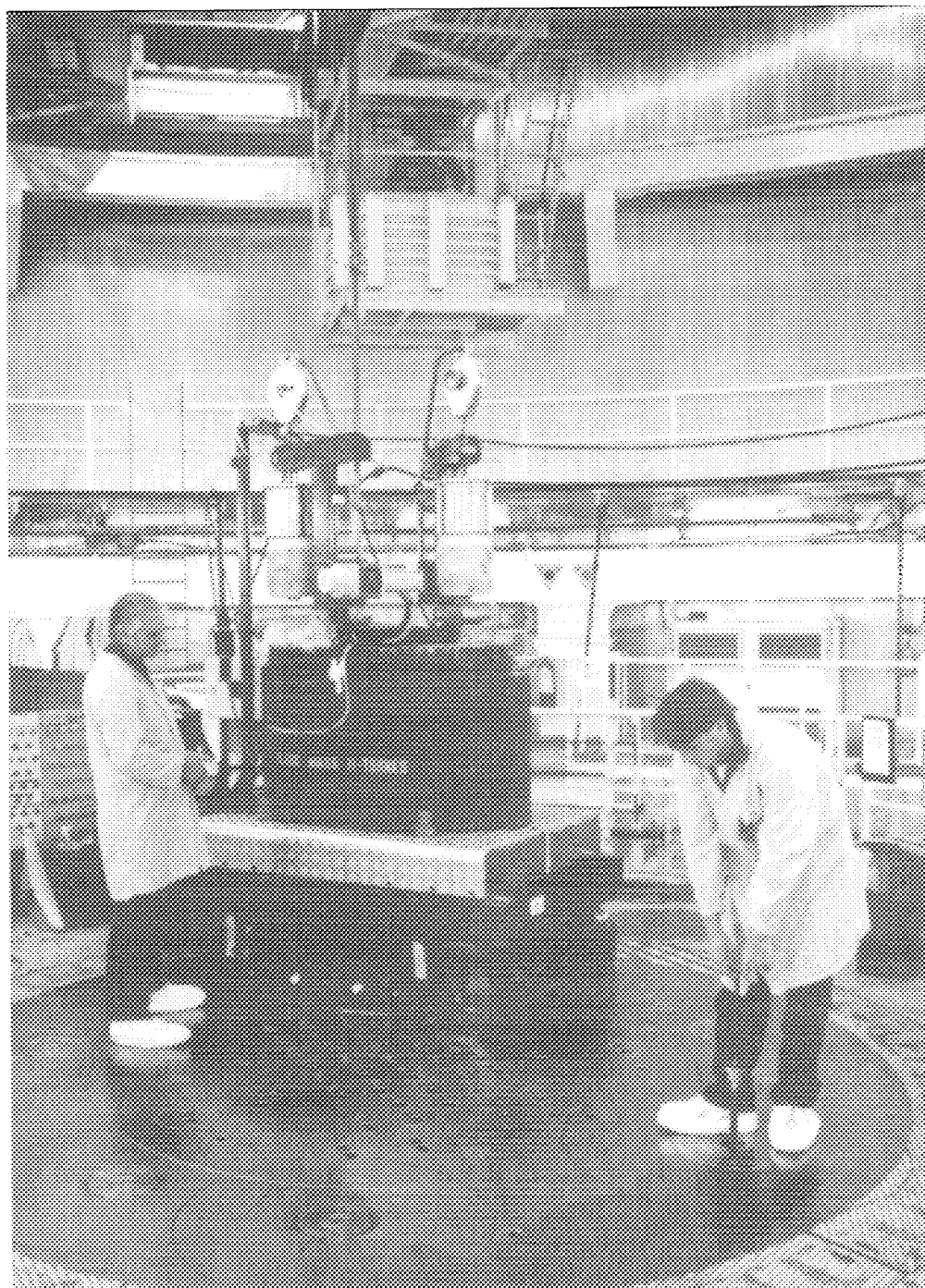
HIFAR Utilisation

During the year, HIFAR operated for 6 647 reactor hours (76% of the available operating time) at an average power of 10 megawatts. There were 3 675 targets irradiated in the reactor facilities to produce radioisotopes for medicine, industry and research. In addition, spare reactor capacity was utilised to irradiate 350 packages for the commercial analysis of 32 356 mineral ore sample requests and 850 packages for neutron transmutation doping (NTD) of silicon. The silicon targets are used in manufacturing a wide range of applications in the electrical and electronic industries.

AINSE funded projects utilised 625 person-days (in instrument usage time) from outside the Organisation, and ANSTO research utilised 315 person-days within the Organisation. In many cases the ANSTO research involved collaboration with university groups and training of PhD students.

HIFAR Operations, Maintenance and Support

Completion of a program of work aimed at updating the Authorisation - HIFAR Operation documentation was made a formal requirement by the Nuclear Safety Bureau for the continued operation of HIFAR beyond April 1995. The Authorisation documentation upgrade was prepared in accordance with the HIFAR Quality System, which complies with AS/NZS ISO 9001. A significant



Preparing to irradiate silicon, in HIFAR, for use in power electronics devices, video cameras and high performance computer applications.

part of the work covered the updating of the Safety Case for the operation of HIFAR. A major submission detailing the extent of the work completed in accordance with the agreed schedule was presented to the Nuclear Safety Bureau.

The HIFAR Quality System development continued. The majority of procedures were completed, including major Quality System documents detailing arrangements for the operation, maintenance, modification and utilisation of the reactor. A project schedule was prepared for the completion of the outstanding documentation, performance of internal audits and formal accreditation to AS/NZS ISO 9001.

All of the reactor operators and reactor shift superintendents were re-accredited in accordance with HIFAR Quality System procedures.

Every four years HIFAR has a scheduled major shutdown to undertake inspection, maintenance and upgrade activities that are not possible at other times. A major program of work was scheduled, and preparations began for the next major shutdown, which is to take place during the last quarter of 1995.

Design was completed and a contract awarded for the replacement of the underground sections of the reactor secondary cooling system piping and the penetration of those pipes through the wall of the reactor containment building. This work will be completed during the scheduled major shutdown.

An integral part of HIFAR's control system is the Reactor Protection System that provides for safe shutdown of the reactor. An important phase of the upgrade of this system was completed with the installation and commissioning of the final two nucleonic channels which replaced obsolete equipment. This

allows the reactor to be shut down when set points on any two of four of these instruments are exceeded.

Waste Management

The continuing upgrade of routine waste management facilities has meant that:

- refurbishment of the laundry and decontamination centre was completed;
- the effluent treatment plant was upgraded with the commissioning of an integrated, computer control system.

Sydney Water Corporation discharge limits have been met and a new three year agreement will commence from July, 1995. This agreement will implement additional agreed reductions in discharges. As in previous years, Sydney Water Corporation officers had unrestricted access to the effluent discharge point for sampling purposes.

Research

Estimates of the consequences of some postulated incidents on HIFAR are revised periodically following further investigations. Such events are analysed even though they are extremely unlikely to occur. A computer program, HIZAPP, was developed to allow a more detailed representation of the reactor and to include a more conservative heat transfer treatment than previously used. This makes it more suitable for simulation of the class of incidents that begin with a loss of coolant flow. Application of HIZAPP to HIFAR has demonstrated that the inherent safety features of the reactor would be very effective in limiting the consequences of such incidents even if the reactor protection systems also fail.

Research has been undertaken into some of the fundamental processes occurring in vapour explosions. While the phenomenon is well known, many of the detailed physical processes involved

remain unresolved. Fluid jets are considered to be important to the initial phase of the explosion. Computations that model jets of fluid have been validated against experiments.

Commercial

A formal Quality System for commercial irradiation services was developed.

Income from neutron transmutation doped silicon irradiation amounted to \$2.2m. Commercial irradiations for the *neutron activation analysis of mineral samples* arising from mineral exploration programs in Australia resulted in \$77 000 revenue generation from Becquerel Laboratories.

Significant effort was also directed to the commissioning of two new irradiation facilities (4VGR) which have been funded by one of the Japanese silicon manufacturers. Trial irradiations were *performed and final modifications are in hand*.

Radiopharmaceuticals

Biomedicine and Health

The Biomedicine and Health Program has a multidisciplinary team of scientists and technical staff contributing to the development of new diagnostic and therapeutic radiopharmaceuticals and radionuclides.

The research effort in 1994-95 concentrated on bioradiopharmaceuticals, molecular radiopharmaceuticals and radionuclide development and dosimetry. Research is supported by pharmacological evaluation, a quality control group and the development of automated equipment for radiopharmaceutical production. Agents developed within the Program are evaluated in clinical trials in collaboration with nuclear medicine physicians at a number of hospitals across Australia.

A collaborative project with the Applications of Nuclear Physics Program has continued to provide useful structural information on biologically active molecules. As part of this activity, ANSTO's powerful computer systems are being used to calculate important molecular properties.

The Program is involved in projects with Australian universities with the support of Australian Institute of Nuclear Science and Engineering (AINSE) grants. Students at the Universities of Sydney, Wollongong and Western Sydney, supported by grants or research fellowships, are working on PhD projects which complement Program research.

Objective

To improve health care in Australia through the development of new diagnostic and therapeutic radiopharmaceuticals based on reactor and cyclotron produced radionuclides.

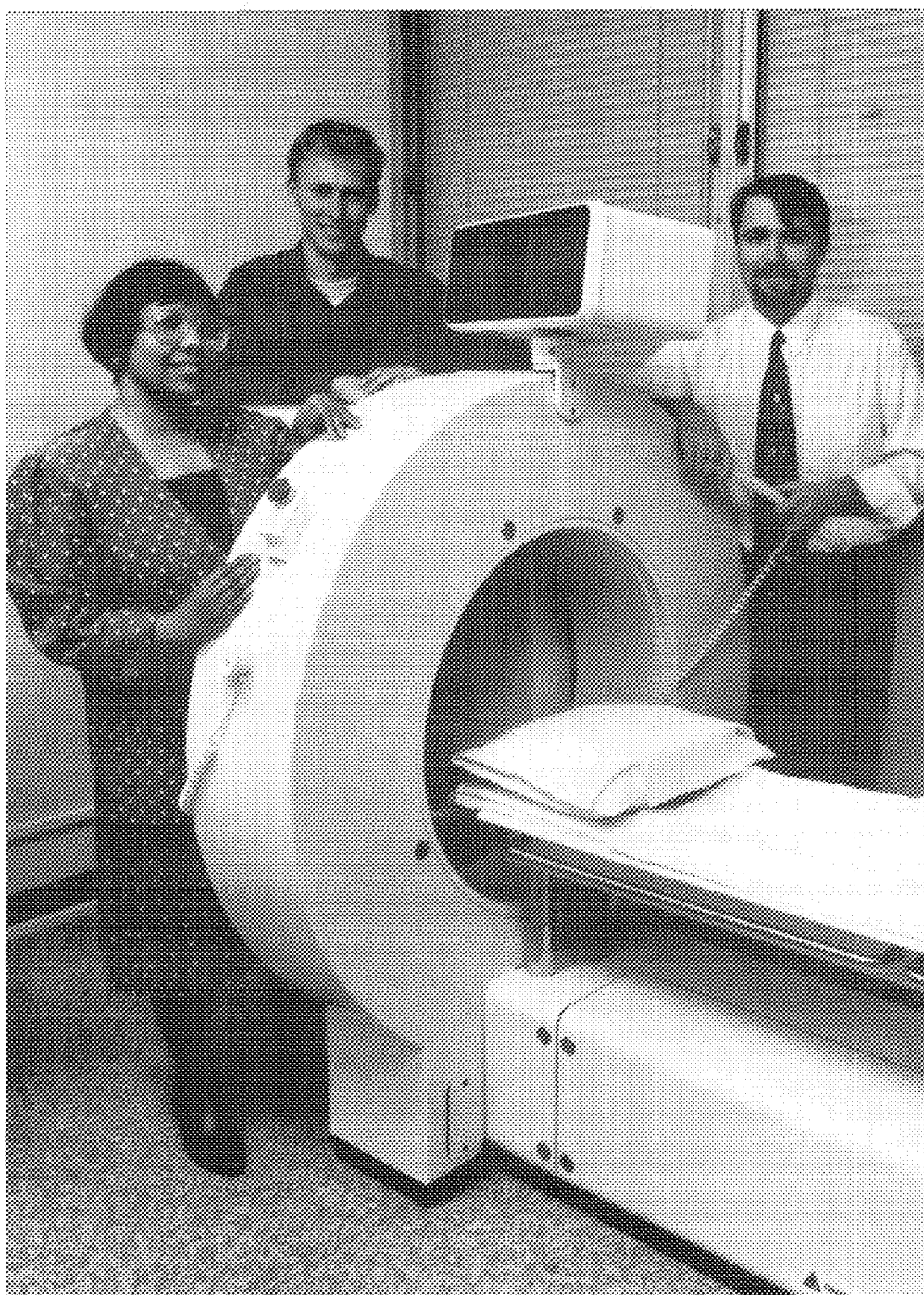
Outcomes

- A pilot study at the Illawarra Regional Hospital, Wollongong, evaluated technetium-99m labelled 3B6/22 monoclonal antibody for the diagnosis of ovarian cancer. The promising results obtained, particularly in monitoring recurrence of the disease, has led to consideration of an expanded trial.
- A study on patients with temporal lobe epilepsy was completed at the Queen Elizabeth Hospital, SA. The study showed that the radiopharmaceutical iodine-123 labelled iododexetimide will permit neurosurgeons to detect the epileptic focus with precision prior to surgery.

Activities and Outputs

The Biomedicine and Health Program has:

- continued research with an emphasis on radiopharmaceuticals for the diagnosis of neurodegenerative disease and the diagnosis or therapy of cancers. Targeting of disease sites for imaging or irradiation is achieved by the use of labelled biological molecules or organic compounds which recognise abnormalities in organ function or



Dr Vivian Fernandes, Peter Schmidt and Todd Donaghy are part of the team from ANSTO and Illawarra Regional Hospital responsible for the evaluation of technetium-99m labelled 3B6/22 monoclonal antibody for diagnosis of ovarian cancer.

diseased tissue. The radionuclides used are produced in either the reactor HIFAR or the National Medical Cyclotron;

- expanded clinical and scientific collaborations within Australia and overseas. Two new clinical trials were initiated. A meeting was held to further the Australia-France collaboration in nuclear biomedicine and exchanges of scientists between the program and the Service Hospitalier Frederic Joliot, Orsay, have continued;

- organised the 4th International Symposium on Advances in Radiopharmaceuticals held in Sydney on 24 February 1995;

- Participated in the work of the IAEA through two Coordinated Research Programs. The Program on Biological Response to Low Radiation Doses was finalised during the year. ANSTO hosted an IAEA Research Coordination Meeting on the Production and Quality Control of Therapeutic Radiopharmaceuticals;

- published 13 papers in refereed journals and presented 26 papers at international and Australian conferences.

Bioradiopharmaceuticals

ANSTO's research on radionuclides with properties making them suitable for use in medicine to diagnose or treat disease is complemented by the development of labelled biological molecules which can target specific disease sites.

Primary and secondary liver cancer are major causes of death in Australia. Lipiodol is used in the delivery of therapeutic drugs to the liver for cancer treatment. The radionuclide rhenium-188 has potential for therapy of primary liver tumours and lipiodol has been investigated as the means of delivering it to the tumour site. Labelling with rhenium-188 is achieved using aminothiols complexes, and several have been studied. Preliminary evaluation at

ANSTO indicates that the labelled complexes are stable with high liver retention and no uptake in other organs.

Other work included the development of methods for labelling proteins with holmium-166, rhenium-188, copper-64 and copper-67. Methods for labelling proteins with copper-64 and copper-67 were developed in collaboration with the Australian National University. A series of gallium-67 hydroxyaryl derivatives of EDTA complexes are being evaluated for use in imaging lymphoma.

Molecular Radiopharmaceuticals

The incorporation of cyclotron produced radionuclides into organic molecules and biomolecules used in drugs, coupled with advances in imaging using PET (Positron Emission Tomography) and SPECT (Single Photon Emission Computed Tomography), allows non-invasive detection of changes in biochemical processes related to many diseases. Thus it is possible to improve diagnosis, follow the progress of a disease, monitor therapy and evaluate new drugs.

Iodine-123 labelled iododexetimide was evaluated for diagnosis of neurodegenerative disease using SPECT. A clinical study of brain abnormalities in patients with Alzheimer's disease was carried out in collaboration with Queen Elizabeth Hospital, SA.

Iodine-123 labelled iodobenzamide is being evaluated in a study of movement disorders and Parkinson's disease (with Sir Charles Gairdner Hospital, WA) and schizophrenia (with Westmead Hospital, NSW). Compounds undergoing pre-clinical evaluation include iodine-123 methyl iododexetimide for use in investigating heart disease and iodine-123 benzodiazepine for investigating epilepsy and dementia.

Work is in progress on the use of cyclotron produced positron emitters carbon-11 and fluorine-18 for labelling

antipsychotic drugs as possible PET based diagnostic agents. Fluorine-18 is also being used to develop novel labelling techniques for preparation of radiopharmaceuticals with potential in the study of movement disorders in collaboration with Royal Prince Alfred Hospital, NSW.

estimate the dose from the same antibody if labelled with rhenium-188. The result indicates that there is potential for development of rhenium-188 labelled 3B6/22 for ovarian cancer therapy.

Radionuclide Development and Dosimetry

The development of radionuclides was identified by the Mission Review as an *area for continued research* at ANSTO. Work in the Program has been focussed on radionuclides with potential for radiotherapy.

Rhenium-188 and holmium-166 are among the few reactor produced nuclides with potential for use in therapy that are available at the high specific activity required for labelling monoclonal antibodies and other biological molecules. A tungsten-188/rhenium-188 generator system is now in use in the Program to supply rhenium-188 for radiopharmaceutical research. Work has continued on methods to separate holmium-166 from the irradiation target and its parent radionuclide dysprosium-166, and a radiochemist from the Program has commenced a six months attachment with the Nuclear Medicine Group at Oak Ridge National Laboratory, USA, to work on improving extraction efficiency.

Preclinical studies of holmium-166 labelled microspheres for therapy of metastases in the liver were completed and a clinical trial, in collaboration with Fremantle Hospital, WA, is planned to commence later in 1995.

The biological data obtained during the *ovarian cancer clinical trial of technetium-99m labelled 3B6/22* monoclonal antibody was used to determine radiation dose to the patients. The same biological data were used to

Radiopharmaceuticals

Australian Radioisotopes

Australian Radioisotopes (ARI), as a commercial arm of ANSTO, produces radiopharmaceuticals and radioisotopes for sale to medical, industrial and scientific markets in Australia and overseas. Located at Lucas Heights, ARI is Australia's only manufacturer of radioisotopes. It sources bulk product from ANSTO's HIFAR nuclear reactor at Lucas Heights and the National Medical Cyclotron, in the Sydney suburb of Camperdown.

ARI is the major supplier of radiopharmaceuticals to public and private nuclear medicine centres in all capital and regional cities throughout Australia.

ARI's mission as an Australian enterprise is commitment to improving the quality of life of individuals and the productivity of industrial activities in Australia, New Zealand and Asia through the developing and providing of safe, high quality radioactive products and support services for their application in healthcare and industry.

Objectives

- To further develop ARI's position in the domestic market for radiopharmaceuticals.
- To improve the quality of customer services.
- To make improvements to manufacturing processes which enhance product quality and provide a safer working place for its staff.

Outcomes

- For 1994-95, the sales forecast was \$10.6 million and ARI's actual sales \$11 million, a 15% improvement over the previous year. The technetium-99m generator, the 'workhorse of nuclear medicine', recorded an increase in sales of 14% over 1993-94, which was greater than the increase of the previous year.

- The strong performance of the thallium-201 market for heart scanning and gallium-67 market for infection detection continued from the previous year, evidenced by the growth in these two segments. Gallium-67 increased sales by 71% and thallium-201 by 28% over the previous year. ARI continued to improve its market share in both products by offering more competitive availabilities and speed of service to meet customers' shorter term requirements. By the end of the year, ARI was able to source almost all of its requirements of thallium-201 and gallium-67 from the National Medical Cyclotron, further evidencing its ability to satisfy both domestic and South East Asian export needs in a more effective manner. Renewed demand for the thyroid diagnostic and therapeutic agent, iodine-131, was experienced during the year, with an increase of 15% in sales over last year.

- ARI's financial result for the year saw revenue increase, but a number of significant operational charges unique to the current year caused earnings to fall below those of the previous year.

Activities and Outputs

ARI's move towards improved manufacturing processes and quality control procedures were enhanced. New mobile dispensing equipment for thallium-201 and gallium-67 in a clean room environment was brought into operation. Computer controlled dispensing equipment was introduced for iodine-131 capsule production, improving efficiency and workplace conditions.

Efforts continued during the year with local, interstate and international transport providers to improve distribution to ARI's domestic and export customers. ARI is a major shipper of urgent medical supplies to nuclear medicine centres in Australia, New Zealand and South East Asia and continually seeks more efficient methods of distribution to improve performance.

ARI operates under the Code of Good Manufacturing Practice (GMP) within the Therapeutic Goods Administration of the Commonwealth Department of Human Services and Health. ARI's commitment to the introduction of a Quality Management System, leading to accreditation under the AS/NZS ISO9000 standard, continued during the year. The need to operate under a Quality Management System is based on a requirement of the Code of GMP which calls for the application of AS/NZS ISO9000 to quality assurance areas not specifically addressed by the Code.

The technical standards committee of the Australian and New Zealand Nuclear Medicine Society undertook a national dose calibrator survey during the year. As a result, the National Standards Commission appointed ARI as a verifying authority for calibration sources under the National Measurement Act regulations.

Further steps were taken during 1994-95 for the introduction of two new products for which licensing agreements were entered into last year:

- Samarium-153 Ethylenediaminetetra-methylenephosphonate (EDTMP), which can be highly effective in pain relief in metastatic bone cancer. Manufacturing methods, specifications and quality control procedures for samarium-153 EDTMP were completed, as well as the construction of dedicated production equipment. Successful manufacturing trials were conducted in the second half of the year to prove manufacturing methods and specifications. Clinical Study Protocols to test pharmacokinetics of samarium-153 EDTMP were completed for use in two test sites during 1995-96;

- The Introduction of the TruScint AD monoclonal antibody product for the detection of breast and ovarian cancer, licensed from Biomira Inc, Canada, has progressed to the clinical study stage. Protocols have been developed with two test sites which will participate in a clinical study in 1995-96.

This year saw a lift in productivity and output. This achievement reflects continued improvement by all staff at ARI in the performance of their mission to provide high quality radiopharmaceuticals, industrial isotopes and support services for application in healthcare and industry.

Radiopharmaceuticals

National Medical Cyclotron

The National Medical Cyclotron (NMC) is a collaborative venture between ANSTO and Sydney's Royal Prince Alfred Hospital. It produces both short and long lived radioisotopes for the diagnosis, prediction and treatment of conditions such as cancer, heart disease and stroke.

Objectives

- To be an efficient and reliable producer of quality cyclotron radiochemicals and pharmaceuticals for national and international markets.
- To foster the development of cyclotron based science and technology.

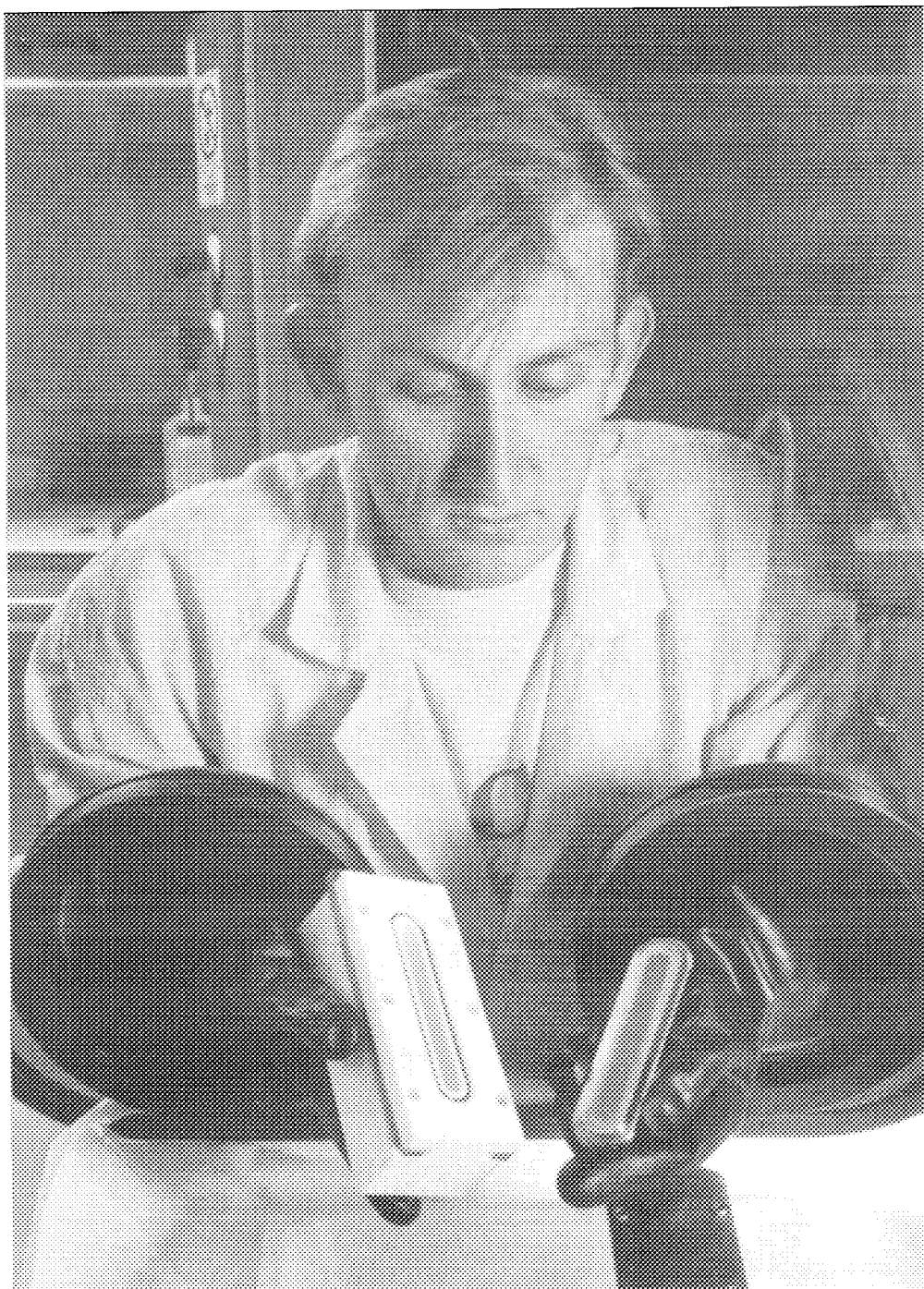
Outcomes

- The NMC produced almost all of Australian Radioisotopes' (ARI) requirements for cyclotron produced medical radiopharmaceuticals, lessening dependence on imports. This arose from improvements to production systems, increased production effort and a reduction in cyclotron down time compared to the previous 12 months.
- Due to a drop in the number of cardiac studies being undertaken at the Royal Prince Alfred Hospital PET (positron emission tomography) Centre, production of pharmaceuticals was marginally below forecast. However, a full year of clinical studies has been completed with an increase in the number of whole body secondary cancer scans and the number of oxygen-15 neurological research studies.

- Bulk thallium-201 and gallium-67 has been supplied to ARI throughout the year and iodine-123 has been supplied on a weekly basis to Biomedicine and Health Program (BMH) at ANSTO and to other centres for clinical trials and research purposes. The development of larger targets will increase production capacity and ARI is expected to incorporate iodine-123 in a new commercial product.

- Having overcome many of the obstacles to optimum, efficient production of bulk chemicals and pharmaceuticals, the NMC is to enter into a more research orientated phase. A project being undertaken at the NMC in collaboration with BMH is the development of a cleaning method for zinc-68 targets used in the production of gallium-67, a common agent for imaging lymphoma. The method has produced a new source of copper-64, which is under investigation for use as a PET imaging agent and therapy radiopharmaceutical.

Further, the purchase of a carbon-11 Methyl Iodide chemistry system and the upgrading of hot cells to accommodate an [F-18]-Dopa system heralds this new direction.



Preparation of a target for use in the production of thallium-201 at the National Medical Cyclotron. Thallium-201 is used for heart scanning by many Australian hospitals.

Corporate Services

The Corporate Services program delivers broad based business services in support of core research and other activities.

While budget dependent, ANSTO operates under its own legislative authority. Its powers include the power to enter into contracts, to acquire property, to engage staff and to operate its own bank account. Functions

consistent with these powers are administered by the Corporate Services Program. During 1994-95 the range of services was unchanged from those delivered in the previous year and included, among other things, financial support, procurement, warehousing, human resource management, industrial relations, security and transport services.

Business Administration

Objectives

- To provide an effective financial and procurement service which is responsive to the needs of both staff and management.
- To maintain the financial Information Management System at a high level of performance.
- To monitor and implement applicable Government budget and financial policies.

Outcomes

The strategic service related objectives of the Program were achieved. The main outcomes were:

- financial and accounting services were delivered consistently, accurately and in good time to all levels of management;

- a new payment processing facility enabled the production of overseas bank drafts and allowed telegraphic transfer of funds on demand without recourse to a bank. This resulted in a reduction in processing cost and improvement in operating efficiency;

- production of financial statements on both half year and full year bases was commenced;

- a Triennium Funding Agreement was negotiated with the Minister for Industry, Science and Technology and the Minister for Finance in accordance with a decision of Government in the context of the 1994-95 Budget. This Agreement provides financial certainty and facilitates longer term planning of resource allocations; and

- achievement of the Government's revenue target set for 1994, of 30% of appropriation funding.

Activities and Outputs

Financial Services

The principal delivery tool, the Prophecy software - based Financial Information Management System (FIMS), was reviewed in the context of a required hardware upgrade decision and confirmed as suitable to meet ANSTO accounting needs over the next several years.

Early in the year it became clear that the existing hardware platform could not support new releases of the Prophecy financial software and that this was acting as a constraint on the delivery of enhanced financial services. Tenders were called for new computing equipment to replace the existing Pyramid mainframe which provides the UNIX hardware platform for the delivery of financial services. The project to transfer FIMS to a new computer will be completed in late 1995. It will provide a viable upgrade path to facilitate the adoption of software enhancements.

In December, a payment processing facility provided by Bank of America was installed in the Accounts Department to enable the production of overseas bank drafts and allow telegraphic transfer of funds on demand without recourse to a bank acting as an agent.

In the context of budget accountability, ANSTO reports to Government on a cash basis, although its formal financial statements are required to be prepared in accordance with the principles of accrual accounting. While retaining an ability to produce cash based financial reports, the ability to capture and report accrual based information has been enhanced. Routine program performance reports now take account of all accrued and prepaid expenditure, but do not yet take account of non-cash (unfunded) transactions, such as depreciation charges and provisions. Financial statements, for the Organisation are produced routinely on a monthly basis in

accordance with the principles of accrual accounting, including non-cash transactions.

Budget

In April 1994, in the context of the 1994-95 Budget process, the Government reaffirmed its support for the concept of triennium funding for ANSTO in accordance with an agreed set of principles. This decision (Triennium Funding Agreement, 1994), provides for the operational arrangements to be documented formally in an Agreement between ANSTO, the Minister for Finance, and the Minister for Industry, Science and Technology. In consultation with ANSTO, officers from the Department of Industry, Science and Technology developed an agreement which was executed by the parties on 26 August, 1995. ANSTO is budget dependent. Accordingly, ANSTO welcomes the Government agreement to reaffirm its commitment to triennium funding, the principles of which are of considerable importance in terms of the funding certainty they provide.

In accordance with the Government's decision, Parliamentary appropriation of \$66.219m was received in 1994-95 (1993-94 \$64.217m) representing a decrease in real terms of 4.11% on the average funding level of the previous triennium. The main reason for the real term reduction was the cessation at the end of June 1994 of Government funding arising from:

- a) the May 1989 Science and Technology Statement; and
- b) additional infrastructure funding initiatives during the last triennium.

A significant element of the Triennium Funding Agreement, 1994, is the variation in the application of the efficiency dividend, which was reduced to 1% and limited in its application to 30% of applicable running cost. The cost in 1994-95 was \$144 800, a reduction of \$326 000 from the previous year.

Revenue

A central feature of the Triennium Funding Agreement is the continued inclusion of external earnings targets and performance indicators that assist measurement of the effectiveness of ANSTO's links with industry. In previous years, ANSTO was set a revenue target equal to 30% of appropriation funding. In line with an Australian Science and Technology Council recommendation, ANSTO has been set an equivalent target, which is expressed as 20% of total income. This target will be viewed flexibly in terms of balancing research priorities and commercial demand.

External revenue generated in 1994-95 totalled \$26.63m (1993-94 \$26.15m), representing 40.21% of government appropriation. This comprised income generated through research and user charges \$11.61m, Australian Radioisotope Operations \$11.01m and other unrelated income \$4.01m. Figure 1 provides a funding profile over the past five years.

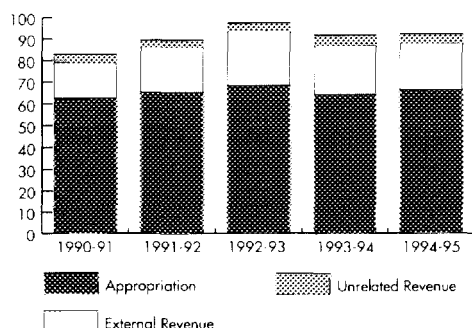


Figure 1: Total available funds in \$m

Expenditure

Expenditure was broadly in line with original budget provisions.

Direct and indirect costs associated with operating the national facilities, as well as support of Government nuclear policies and initiatives, accounted for

46% of total outlay (excluding provisions and unfunded charges). The remaining 54% of expenditure was spent on research or activities in support of research.

Salaries and payments in the nature of salaries accounted for 49% of total outlay and remained the largest single component of running cost.

A significant event for the year was the ratification of the second enterprise agreement, (ANSTO Enterprise Agreement, 1995) which took effect from 29 December 1994. As a consequence, salaries expenses increased by \$827 000 in 1994-95 (\$3.6m for the life of the Agreement). Identified reforms, including a commitment to a continuous workplace reform process, are expected to yield productivity improvements and recurrent savings in running costs over the life of the agreement to permit the implementation of the agreed salary increases without diversion of funds from scientific projects or capital expenditure programs.

On behalf of its employees, ANSTO contributes to two superannuation schemes, the Commonwealth Superannuation Scheme (CSS) and the Public Sector Superannuation Scheme (PSS). It meets liabilities as costs accrue, on the basis of contribution rates set by the Australian Government Actuary (AGA). Based on advice from the AGA in August 1994, ANSTO revised its contribution rates to the two schemes. A net additional \$610 000 employer superannuation contribution payment was incurred as a result.

ANSTO was required to comply with Australian Accounting Standard 30 - Accounting for Employee Entitlements, for the first time this year. The adoption of the standard has resulted in a change in the method of calculating ANSTO's long service leave and sick leave liabilities. ANSTO now provides for long service leave in respect of all

employees, based on present value of the estimated future cash outflow to be made resulting from employees' services, and recognises as liability the portion of the accumulated non-vesting sick leave at balance date. The financial impact was a reduction of \$32 683 in leave provisions for the year.

In recognition of accruing but yet to emerge obligations, and in accordance with the principles of accrual accounting, ANSTO has created the following formal provisions at 30 June 1995:

- a provision for the cost of return and reprocessing of HIFAR spent fuel in an amount of \$4.4m; and
- a provision for treatment and disposal of existing waste from past operations in an amount of \$3.0m.

Additionally, a formal reserve has been created to recognise a proposed major new liability to be created in 1995-96 for the supply of a large quantity of fresh fuel elements for the reactor HIFAR in an amount of \$6.5m.

A broad profile of expenditure over the 5 year period is provided in Figure 2.

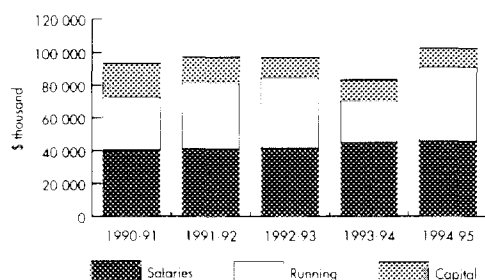


Figure 2: ANSTO Expenditure by category in \$m

Internal Audit

The ANSTO Audit Committee, established in December 1993 as a sub-committee of the Board, has met regularly during the year. This Committee consists of three members of the ANSTO Board, a person external to ANSTO and the Executive Director. The role of the Audit Committee, which derives from the Board's responsibility under section 10 (1) of the ANSTO Act, is to ensure the proper and efficient performance of the functions of the Organisation. The Executive Director is responsible for the performance of the routine audit function.

During 1994-95 the internal audit function was carried out under a contract by the accounting firm Price Waterhouse. The scope of the audit included a risk-based review of the Financial Information Management System (FIMS), a review and assessment of the Corporate functions, a business efficiency audit of the Engineering Program, as well as continuous monitoring and testing of the financial transactions of the Organisation. As at 30 June, all required actions on specific audit recommendations have been effected by responsible managers.

The audit of ANSTO annual financial statements, in accordance with the provisions of the Audit Act 1901, was performed by the Australian National Audit Office.

Insurance

ANSTO has adopted a risk management policy which includes procurement of external insurance cover for a range of risks including professional indemnity, public and product liability, and research specific risks. The insurance cover is designed to limit ANSTO's risk exposure in the conduct of its commercial and technology transfer activities. ANSTO continues to act as its own insurer in accordance with Government Running Costs arrangements.

Corporate Services

Commercial

The Commercial Program provides an advisory service and otherwise acts as an interface between researchers and external clients.

Objectives

- To establish new links and improve existing links with Australian industry.
- To develop the Business and Technology Park.
- To raise ANSTO's business profile in all Australian States.

Outcomes

- Externally generated revenue exceeded the target set by Government.
- Businesses undertaken in consultation with partners traded profitably.
- A new Triennium Funding Agreement with the Minister for Industry, Science and Technology and the Minister for Finance commits ANSTO to continuing commercial revenue targets as a performance measure of its success in building links with industry.
- A new customer report sheet was developed for implementation in 1995-96.

Activities and Outputs

In the context of the development of a Triennium Funding Agreement with the Minister for Industry, Science and Technology, and the Minister for Finance, the need for ANSTO to continue to

maintain existing links and to forge new links with Australian industry was strengthened. The Agreement provides continuation of the existing policy for ANSTO to retain all external earnings without any related reduction in direct appropriations. Concurrent with this initiative, the Agreement formalises the continued application of external earnings targets as a performance measure of the Organisation's effectiveness to maintain and improve its links with industry. In a departure from the past basis of performance measurement, which matched revenue as a percentage of total appropriation, the new performance indicator is based on a new formula which measures revenue derived from reasearch, user charges and Australian Radioisotopes operation (\$22.62m) as a percentage of total income. For 1994-95 actual performance expressed for both indicators was:

- 40.21% against a target of 30% of total appropriation; or
- 24.36% against a target of 20% of total income.

To further promote ANSTO's potential for assisting Australian industry and to assist and support researchers in marketing their skills, a new Office for Business Collaboration will be created in 1995-96. The first appointment to this Office is expected within this calendar year.

Resources sufficient to discharge existing obligations to existing tenants only were applied to Technology Park development. Except for the Australian Numerical Simulation and Modelling Services (ANSAMS) business, formerly conducted

in partnership between ANSTO and Fujitsu Australia Limited and which ceased occupancy in June 1994, all pre-existing tenants in the A J Woods Centre within the Technology Park remain.

Individual business interests maintained throughout 1995 included:

- Australian Centre of Advanced Risk and Reliability Engineering (ACARRE)
ANSTO has a 50% interest in this limited by guarantee company. The business provides a service to government in the fields of education, research and consulting. The ACARRE financial year to 31 December, 1994 was its most profitable year to date;

- Tracerco
Under a partnership arrangement with ICI of Australia Limited, ANSTO has a 49% interest in this venture. Tracerco is

a commercial business concerned with the application of radioisotope technology to the solving of problems in industrial process plants. The business generated a small profit for the financial year ended 30 September, 1994.

The former wholly owned subsidiary companies, Fox Laboratories Limited and Pluteus Limited, were in a state of Members Voluntary Liquidation throughout the year. Formal deregistration is imminent.

Intellectual Property

Streamlining of numerous patent procedures delivered considerable savings in the cost of maintaining the ANSTO patent portfolio. The patent profile at 30 June, 1995 is disclosed in the table below:

	Wholly owned by ANSTO	Ownership shared with CSIRO	Ownership shared with ANU	Total
Cases under Application	15	0	11	26
Cases with Patent status	15	22	68	105
Total cases	30	22	79	131

Portfolio Evaluation

As outlined in the Department of Industry Science and Technology Portfolio Evaluation Plan 1995-97, and as referred to elsewhere in this document, a comprehensive review of ANSTO's mission was undertaken during the year. Following consideration of the report, the ANSTO Board has developed

specific recommendations and a Strategic Plan is being developed.

The following table provides an overview for the period 1994-97. The Portfolio Evaluation process is undertaken in tandem with a three year rolling internal audit program supervised by the Audit Committee of the ANSTO Board.

Program 10 - Nuclear Science and Technology

Evaluation Title	1994-5	1995-6	1996-7
Review of ANSTO Mission	C		
Review of cooperation between ANSTO into CSIRO	U		
Review of ANSTO Health and Safety		U	

Key: C - Completed U - Underway

Note: All other Evaluations as listed in the 1993-94 Annual report are incorporated in the internal audit program referred to above.

Corporate Services

Personnel and Services

An integral part of the Organisation's support structure for research and related programs is the provision of a human resource service responsible for personnel policy, pay and conditions, industrial relations and site services.

Objectives

- To provide a framework for the management of ANSTO's human resources in line with exemplary employer practice and to be responsive to the needs of both staff and management.
- To provide an industrial relations environment conducive to the achievement of the Organisation's strategic objectives.
- To monitor the outcomes of the Australian Nuclear Science and Technology Organisation (Enterprise Bargaining and Productivity Enhancement) Agreement 1992 and contribute to the implementation and monitoring of a further agreement (the Australian Nuclear Science and Technology Organisation Enterprise Agreement, 1995).
- To maintain the operations of the human resource management information system at a high level of performance and provide timely and accurate information.

Outcomes

The strategic service related objectives of the Program were achieved. The main outcomes were:

- a fortnightly payroll service;
- detailed conditions advice and a monitoring and auditing role of decentralised human resource functions;
- operation of and training in new flextime provisions, the Privacy Act, General Leave, Equal Employment Opportunity, Harassment Contact Officer responsibilities and a review of reference advisory panel policy and operations;
- implementation of Phase 2 of the ANSTO buffer zone management plan enabling control of noxious weeds, pest eradication, minimisation of soil erosion, completion of a comprehensive bush fire reduction plan and replanting of garden areas with native vegetation. This year a eucalyptus tree planting project was implemented in conjunction with Taronga Zoo and the local community. When mature these trees will provide a food source for the Taronga Zoo koala population;
- the extension of the site recycling program which directly resulted in a reduction of refuse into the local landfill from ANSTO;
- a successful continuing program of work experience for students from local schools and Universities. Seventy secondary school students were provided with work experience in accordance with their career choice. A further 20



Students from Lucas Heights Community School planting eucalyptus trees at ANSTO. The trees will be cropped as a food source for Taronga Zoo's koalas.

undergraduate students were provided with 10 weeks experience in a wide range of nuclear science and associated technologies during their summer vacation;

- no actual time loss through industrial disputation. Some work bans occurred during the bargaining period leading to the certification of the ANSTO Enterprise Agreement, 1995. The implementation of this Agreement has resulted in a stable industrial relations environment;
- ratification of the second Enterprise Agreement, 1995, from 29 December 1994. The Agreement is innovative and maintains a continuing process of workplace reform, productivity improvement and effectiveness.

Of particular importance is the absorption of the annual leave loading into the base salary and the 'one-off' payment of disability payments for the life of the agreement. The 1994 decision

of the Industrial Relations Commission in respect of carer responsibilities was recognised. A new category of leave called General Leave was introduced, replacing all sick and special leave accruals. Half pay sick leave was abolished. Staff accrue 15 days General Leave annually.

General Leave is accessible for sick, special, carer's responsibilities or observance of ceremonial, cultural or religious celebrations of conscientious significance. This latter provision recognises a multicultural Australia and acknowledges Government policy in respect of indigenous Australians.

Maximum awareness of the benefits of changed employment conditions was conveyed through a number of briefing sessions to all staff.

Staff numbers at 30 June, 1995

	Full Time Male	Full Time Female	Part Time Male	Part Time Female
Executive Director		1		
Corporate Executive	15			
Professional Officer	149	33	1	3
Research Scientist	93	18		
Technical Officer	243	25		2
Administrative Service Officer	41	81		10
Craftsperson	84	4		31
TOTAL	625	162	1	46

Total staff: 834

Number of temporary staff: 16 (included in 834 figure)

Corporate executive information

Band 3 Corporate Executive - 2 full time male
 Band 2 Corporate Executive - 6 full time male
 Band 1 Corporate Executive - 7 full time male

Corporate Services

Equal Employment Opportunity (EEO)

Objectives

- To ensure that 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.
- To ensure that ANSTO provides a good example of best EEO practice through implementing policies and measures for women and members of designated groups.

Outcomes

The strategic legislative related objectives of the Program were achieved. The main outcomes were:

- consultation with EEO and designated groups in respect of the ANSTO Enterprise Agreement, 1995, to seek

their concurrence with reforms prior to certification. This Agreement addressed a number of ANSTO-specific EEO issues, particularly in relation to the family, on-site child care facilities and access to General Leave for carer's responsibilities and the observance of ceremonial, religious or cultural events of conscientious significance;

- reinforcement of ANSTO's EEO commitment to fully integrate EEO throughout management and staff was addressed during the year by conducting training sessions with all Programs on EEO policy;
- updated guidelines on the prevention of workplace harassment were prepared and promulgated by the EEO committee, which held regular meetings to plan and promote ongoing implementation and awareness of the EEO policy;
- three female staff were given training on career development through the external SPRINGBOARD Program; and
- ANSTO appointed its first female Executive Director. The number of women employed increased by 2% to 25%.

Summary of EEO Statistics as at 30 June 1995 Total Staff = 834

	Numbers Employed	% of Total Staff	Average Salary
Women	208	25%	\$38 503
Men	626	75%	\$47 249

Specific Employment Categories

	Numbers Employed	Average Salary
People with disabilities	27	\$47 974
Aboriginal and Torres Strait Islander People	3	\$40 792
People from non-English speaking background	146	\$44 862

Note: Specific data in relation to 'Specific Employment Categories' is currently held for 334 staff who volunteered the information.

Corporate Services

Security

Objectives

To provide an effective security service which is responsive to Program needs.

To maintain at the Lucas Heights Research Laboratories adequate physical protection systems and controls to ensure protection of the nuclear facilities and materials, classified and sensitive information, Commonwealth assets and operations and to provide appropriate security assessment of staff and contractors.

To upgrade security technology on a cost effective basis.

systems, electronic access control, relocation of nuclear material vaults and construction of new car parks outside the fenced area. It is anticipated that the upgrade program will be completed by December 1995. Completion will permit some relaxation of security measures for the rest of the ANSTO site.

Outcome

- A two year program of work endorsed by the Australian Safeguards Office, and separately funded by the Commonwealth, upgraded the physical protection arrangements applying to the HIFAR research reactor and nuclear materials held on site.

The new arrangements comply with contemporary International Atomic Energy Agency guidelines.

The work involved the rationalisation and segregation of nuclear fuel cycle activities into a separate protected area adjacent to the reactor HIFAR at the western end of the site.

The new arrangements include a new fence around the HIFAR environs, improved detection and surveillance

Corporate Services

Fraud Control

Objectives

To reduce the opportunity for fraud:

- through a system of asset accountability; and
- by detection, investigation and prosecution of individual cases of fraud.

1995-96 a detailed fraud risk assessment will be undertaken covering all business and other activities. Based on its outcome, the Fraud Control Plan will be further reviewed, amended as appropriate, finalised and issued.

Outcomes

- An audit of ANSTO operations in the context of potential fraud indicated that it operates in a low risk environment. Audit reports throughout the year consistently reported evidence of sound internal controls and effective management.

The ANSTO audit function has been significantly strengthened by the establishment of an Audit Committee, a sub-committee of the full Board which meets at least quarterly.

- A draft Fraud Control Plan was developed, based on a platform of education and promotion of an organisation-wide culture to be alert for and to report all actual or potential incidents involving fraud.

This draft Plan is now subject to review following the December 1994 Interim Ministerial Direction on Fraud Control issued by the Minister for Justice. In accordance with this Direction, the central element of ANSTO's fraud prevention strategy will be a formal fraud risk assessment process. During

Information Services

Information Services coordinates ANSTO's interfaces with its stakeholders in government, international organisations, overseas counterpart organisations and the Australian public, together with information support services to ANSTO staff in the areas of computing and library. As a key government scientific research organisation, ANSTO is in the business of developing specialised scientific and technical information resources and expertise and making these available to its stakeholders. The high profile of nuclear related issues both within Australia and overseas and the rapid growth of nuclear

developments in our region underline the importance of ANSTO's role in maintaining a strong resource centre for nuclear expertise in Australia.

The significant growth in information technologies and management practices throughout government and industry in Australia has reinforced the impetus for ANSTO to develop flexible and new approaches to the efficient management of its information. This is being achieved through the ongoing development and implementation of strategic policies and procedures suited to the multidisciplinary single-site ANSTO context.

External Affairs

Objectives

- To facilitate the effective promotion of ANSTO's and Australia's national and international strategic interests in nuclear technology and to support Australia's nuclear non-proliferation, safeguards and wider nuclear technology policies and interests.
- To facilitate the delivery of technical and policy advice on nuclear science and technology issues to relevant national and international organisations.
- To ensure effective liaison on policy issues between ANSTO and external organisations.

Outcomes

- Continual liaison with ANSTO's stakeholders in the national interest area and provide prompt and informed advice on nuclear issues.
- A strong ANSTO presence in the Asia Pacific region, stemming from its network of bilateral and multilateral links with counterpart organisations in regional countries.
- Full compliance by ANSTO with its national and international nuclear safeguards obligations.

- Through its network of bilateral and multilateral regional links with nuclear organisations in the Asia Pacific region, developed support for Australia's successful position in promoting indefinite extension of the Nuclear Non-Proliferation Treaty (NPT) at the NPT Review and Extension Conference held in April - May.

Activities and Outputs

As Australia's national nuclear institute, ANSTO continued to act as the technical base for Australia's relationship with the International Atomic Energy Agency (IAEA). ANSTO officers participated in a wide range of IAEA expert and consultant meetings on safe operation of research reactors, radiation processing, industrial radiotracers, radioactive waste management, the implementation of the International Convention on Nuclear Safety, and the development of an International Convention on the Safety of Radioactive Waste Management. Fourteen scientists and engineers from regional countries received training and experience at ANSTO in such fields as environmental monitoring, radiation protection, surface water hydrology and radiopharmaceutical production using ANSTO facilities during the year under the IAEA Fellowship scheme.

The Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA) has a membership drawn from countries advanced in nuclear developments. Participation in NEA activities enabled ANSTO to keep abreast of current trends and developments. ANSTO has direct access to the OECD database in Paris and contributes to OECD/NEA programs on nuclear safety, radiation protection and public health, storage of spent fuel, nuclear science and radioactive waste management. ANSTO's Counsellor (Nuclear), London, participated in key meetings of NEA Standing Committees.

IAEA Regional Cooperative Agreement

ANSTO has continued its involvement in the IAEA Regional Cooperative Agreement (RCA) for Research, Development and Training related to Nuclear Science and Technology. The Director of Information Services represented Australia at the General Conference meeting of RCA members in Vienna in September 1994 and the 17th Annual Working Group meeting in Malaysia in March 1995. In February 1995, ANSTO hosted the RCA national coordinators' meeting on nuclear analytical techniques.

ANSTO continued to be active in the Australian-sponsored project on The Applications of Isotope and Radiation Technology to Regional Development with Special Reference to Industry and Nuclear Medicine, receiving two-thirds of the funding of \$1.5 million being provided over three years by AusAID. ANSTO has been responsible for implementing a series of national seminars on the application of nuclear techniques to industry in several regional countries and the development and testing of training material for radiation protection using distance learning techniques. A series of modules based on the concept of distance learning were developed for training technologists in radiation protection, with trials to be completed by 1996.

ANSTO hosted RCA regional training courses on nuclear techniques in materials science in March 1995 and strategies for applied marine radioactivity studies with the Australian Institute of Marine Science in November 1994. It co-hosted an RCA regional workshop on off-site planning and countermeasures for radiological emergencies with the Australian Radiation Laboratory in September 1994.

Bilateral and Multilateral Cooperation

Under ANSTO's ongoing bilateral agreement with France's Commissariat à l'Energie Atomique (CEA), a workshop on nuclear medicine involving ANSTO's Biomedicine and Health Program and other Australian researchers was held in Sydney in February. Arrangements were concluded to extend the cooperative arrangement for research in nuclear science and technology with the Korea Atomic Energy Research Institute. Firm linkages were maintained with the Japan Atomic Energy Research Institute, particularly in the field of radioactive waste management. The latest three year Australia-Malaysia nuclear technical cooperation project is due to officially end in July 1995. This project has been most successful in terms of technology transfer and human resource training in the areas of nuclear medicine, applications of radioisotopes, and occupational health and safety.

A regional meeting on radiopharmaceuticals and nuclear medicine was held in Sydney in February within the framework of the International Conference on Nuclear Cooperation in Asia (ICNCA). This grouping contains membership of eight NPT Member States in our region. This workshop was the fourth in a series sponsored by ANSTO and involved the Biomedicine and Health Program and Australian Radioisotopes. Two ANSTO officers attended the ICNCA workshop on the utilisation of research reactors held in Indonesia in November 1994. The Australian delegation to the ICNCA annual meeting held in Tokyo in March was led by ANSTO's Acting Executive Director.

Overseas Linkages ('Big Science')

ANSTO has continued its contribution to the Australian National Beamline Facility at the Photon Factory, Tsukuba, Japan. ANSTO manages this project on behalf of a consortium made up of ANSTO,

CSIRO and Australian universities. Commissioning of the major instrumentation of the facility was completed and a range of research projects was undertaken by Australian scientists.

Overseas Representation

As an integral part of its international linkages, ANSTO maintains specialised representation through three Counsellor (Nuclear) posts based at the Australian High Commission, London, and Australian Embassies in Vienna and Washington DC. These posts facilitate technical contacts with the OECD/NEA and the IAEA and provide essential linkages between ANSTO and those geographical regions most active in nuclear science and technology. In November 1994 Dr Ross Jeffree replaced Dr Geoff Durance as Counsellor (Nuclear) London.

National Science and Technology Activities

ANSTO's contribution to the national direction of science and technology continued through the Executive Director's membership of the Coordination Committee on Science and Technology (CCST) and the International Science and Technology Advisory Committee (ISTAC), and through input to studies undertaken by the Australian Science and Technology Council (ASTEC), by the Industry Commission on research and development in Australia, and by the Parliamentary Standing Committee on Industry, Science and Technology on innovation issues.

Nuclear Services

ANSTO participated in the bilateral nuclear safeguards and co-operation consultations with Japan held in Tokyo, and with the Republic of Korea held in Seoul. The Australian Safeguards Office (ASO) conducted monthly inspections and audits of ANSTO's nuclear materials. IAEA safeguards inspectors conducted four routine inspections to verify ANSTO's nuclear materials which

demonstrated full adherence by ANSTO to all requirements. In addition to the routine inspections, an unannounced inspection of the Lucas Heights Research Laboratories (LHRL) by IAEA safeguards inspectors took place in March.

ANSTO continued to provide its dry spent fuel storage facility for a major trial of remote monitoring equipment for safeguards purposes. The trial is a co-operative project between ANSTO, ASO and Sandia National Laboratories, USA, representing the United States Department of Energy (USDOE), and is expected to last a further two years.

During the year, regular quarterly reviews of overseas events relating to nuclear power and the nuclear fuel cycle were issued and information was provided in response to requests from government, the media and the public. A particular focus of interest was the return to Japan of a shipment of vitrified high level waste resulting from the reprocessing in France of spent fuel from Japan's nuclear power program. A detailed report on the technical aspects of the shipment was prepared and distributed.

The remainder of the Government's uranium stockpile holdings at the LHRL, amounting to some 239 tonnes of uranium oxide concentrates, was shipped in July to the United States for sale to North American electricity producers. ANSTO acted as technical adviser to the Department of Finance Task Force on Asset Sales (TFAS) in checking and safely packing for transport the 976 drums in 21 freight containers in accordance with regulatory requirements. Considerable follow-up advice was also given to TFAS in connection with the sampling and analysis of the material preparatory to chemical processing in the US.

Again, considerable effort was devoted to progressing the long-term disposition of HIFAR spent fuel. ANSTO was represented at international meetings on

spent fuel, including the IAEA Advisory Group on a Database for Research Reactor Spent Fuel and a USDOE Seminar on Spent Fuel Issues. Return of US-origin spent fuel to the United States was pursued actively through participation in the Edlow Group of research reactor operators and through direct dealings with the USDOE in the development of an Environmental Impact Statement (EIS) on renewal of the return of spent research reactor fuel policy. Extensive comments were provided to the USDOE on the draft EIS following its release in April. Consultations were also pursued with European research reactor operators and with the United Kingdom Atomic Energy Authority in the context of possibilities for reprocessing fuel at the UK's Dounreay facility. Nuclear Services Section was also active in the development of an inter-agency review of HIFAR spent fuel options commissioned by the Government.

A program was commenced for examining the spent fuel dry storage facilities at the LHRL with a view to establishing the continuing integrity of this storage.

Radioactive Waste Management

About 2 000 cubic metres of slightly radioactively contaminated soil originating from a CSIRO laboratory site at Fishermens Bend, Melbourne, was transported by the CSIRO from the LHRL to the Rangehead, near Woomera, over the period November - January. The soil had been stored at the LHRL on an interim basis since 1990 and was subject to an order by the NSW Land and Environment Court requiring its removal by 5 February 1995.

ANSTO conditioned 40 cubic metres of radioactive waste at the Australian Defence Industries site at St Marys to enable this waste to be also transported to Woomera in May. The conditioning work by ANSTO required the enactment of a regulation pursuant to Section

5(1)(ba)(iv) of the Australian Nuclear Science and Technology Organisation Act 1987. The final drafting of the Regulation followed a hearing by the Senate Legal and Constitutional Legislation Committee at which ANSTO gave evidence.

In June, the Minister for Industry, Science and Technology established an independent review to be conducted by Mr Michael Codd AC of the arrangements for the movements of the above radioactive waste from NSW to Woomera. The Minister stated that these transfers were complex exercises which were handled competently by all concerned and they presented no threat to public safety. The review will, however, establish whether any improvements are possible in movement of similar waste in the future.

A detailed submission was made to the Senate Select Committee on the Dangers of Radioactive Waste. Verbal evidence was given to the Committee at a hearing in Canberra in June. The Committee has wide terms of reference to inquire into the management of radioactive waste in Australia.

Ongoing support was provided to Departments in relation to the establishment of a national near-surface radioactive waste repository for low and short-lived intermediate level waste.

Ecologically Sustainable Development

The goals, core objectives and guiding principles of the national strategy on Ecologically Sustainable Development are recognised and progressed in ANSTO's activities.

Information Services

Communications

Objectives

- To enhance understanding of ANSTO's activities by providing timely, accurate and relevant information about the Organisation to the general public, the news media, educationists and students, and to the staff of the Organisation.
- To provide design and production services for ANSTO's printed publications and exhibition needs, and photographic services to Organisation users.

Outcomes

- A comprehensive, structured approach to facilitating improved communications with staff, the community, media and educationists was devised and endorsed by the Board. It is anticipated that the ongoing implementation of this plan will lead to a wider appreciation and recognition of the unique contribution being made by ANSTO to the Australian community.
- After extensive discussions with local community groups, a formal consultative process was put in place, with regular meetings attended by representatives of Sutherland Shire organisations such as Precinct Committees, Progress Associations, the Sutherland Shire Environment Centre and other interested individuals. The Sutherland Shire Council has observer status at the meetings, which are managed by an independent facilitator.

- A Standing Operating Procedure for the coordination of media during an emergency was developed in conjunction with the NSW Police Service media unit.

Activities and Outputs

Better relationships were developed with local news media through familiarisation visits to ANSTO. A more continuous flow of information, mixing hard and soft news stories, has been instituted.

A more assertive campaign was put in place to promote understanding of ANSTO facilities and services to educationists and students. Through attendance at key education conferences, direct consultation with teachers, advertising and a newsletter for teachers, school visits to ANSTO and requests for information from teachers and students are well above those of last year.

Numerous talks were given to community and school groups either by members of the Communications Unit or by specific ANSTO experts coordinated by the Unit. Public tours of ANSTO remain popular, with more than 8 000 visitors using the tours facility in the year.

A highly successful series of Open Days for academia and industry, educationists and students and the general public was held over three consecutive days in September. More than 5 000 people visited the Lucas Heights Research Laboratories site.



Some of the 5 000 visitors to ANSTO during its 1994 series of Open Days.

The permanent display area in the Reception Centre was altered to place more emphasis on the applications of ANSTO's research and the benefits they deliver to the community. A reading area was also set up in the Reception Centre to encourage community access to a wide range of ANSTO publications and reports.

The design section of the Communications Unit provided a high quality creative component of the Organisation's publications and presentations. Demand remained high from across the Organisation for quality photographic services, with more than 250 assignments completed in the year.

service activities

Information Services Library

Objectives

- To operate a dynamic and effective service which provides access to, and delivers, quality information services and products in support of ANSTO's research and development, commercial and other activities.

Outcome

- The Library represents the main centre of bibliographic information in Australia in nuclear science related fields. Reviews of the journal, pamphlet and lending collections were conducted to ensure that Library collection activities focused on the research and commercial needs of the scientific Programs.

Activities and Outputs

A serials retrospective conversion project was completed and a project commenced to validate holdings data in preparation

for future stocktaking and data conversion activities.

Networked access to local and Internet electronic information resources was expanded, including Medline, FirstSearch, TGA (Therapeutic Goods Act) and Business Who's Who. Resources available through the Internet continued to be monitored and accessed for potential application by clients.

Staff represented Australia and provided expert advice at a number of International Atomic Energy Agency meetings in Vienna, including a regional nuclear information project and an International Nuclear Information System (INIS) strategic directions meeting.

Library staff also contributed to ANSTO's Information Management Strategic Planning process, including information mapping, roles and responsibilities, networks and emerging applications of information.

Information Services

Computing Centre

Objectives

- To provide a stable, efficient and secure Information Technology service to users.
- To extend the availability and reliability of the ANSTO computing network and its associated resources to users.
- To collaborate with other Program areas and assist them in the application of high performance computing, visualisation and other associated technologies.

Outcomes

Some of the significant outcomes from the activities of the Computing Centre were:

- greater functionality and reliability of the ANSTO Financial and Information Management System. This included, for example, a number of upgrades to software and the ability to transfer information from the Prophecy financial package to a personal computer for further analysis. It also involved an evaluation of a replacement hardware platform;
- the development of a database for use by scientists using the tandem accelerator;
- the installation of a higher reliability and faster site network;
- significantly increased usage of high performance computing facilities;
- completion of the first stage of a commercial research and development project for Fujitsu Japan;
- a high level of availability of corporate computer systems and the network.

Activities and Outputs

The Centre assumed responsibility for the operation of the Fujitsu VP2200 supercomputer following the dissolution of the partnership between ANSTO and Fujitsu Australia Ltd known as Australian Numerical Simulation and Modelling Services. A new maintenance contract was entered into with Fujitsu Australia which provided for reduced maintenance costs for the VP2200. Also, with the new focus of effort on the internal use of the machine, a considerable increase in its use by scientists on site was generated. Despite considerable effort, external utilisation of the machine remained low.

The network reliability was significantly enhanced this year with the installation of a high speed backbone. The network has become increasingly important to the Organisation as a mechanism for transferring information, both internally and externally.

The Centre has been involved in the generation of a number of commercial reports and videos in conjunction with other Programs. It completed the first stage of a commercial research and development project for Fujitsu Japan. This resulted in a technique for high speed visualisation of the output from calculations on the VP2200 supercomputer using a graphics workstation. It was used for market research purposes to determine the requirements for the next stage of a project that will result in the development of a commercial product for scientific visualisation using workstations. The Centre assisted Wollongong University with a project for Fujitsu Japan using neural networks for simulating financial decision making.

Information Services

Information Management Strategy

Effective information management is an essential element in supporting ANSTO's scientific and commercial activities. The Organisation has therefore placed importance on defining its information needs and future directions in a systematic manner. At its meeting in November, the Board endorsed the scope of a draft ANSTO Information Management Strategic Plan (IMSP) and the ongoing steps needed to be taken. A number of strategies were identified relating to the key performance areas of:

- information systems awareness and training;
- security, privacy and availability;
- standards;
- information management structure and planning; and
- information technology.

A draft prioritisation and implementation options paper was developed, based on the IMSP, which identified eight key project areas. A consultancy was let to Price Waterhouse to assist in the preparation of this options paper. A project team was established to work on four of the project areas identified. These projects were roles and responsibilities, government reporting requirements, standards, and information mapping. A series of cross-Program task forces were used to provide essential input to the IMSP. It is planned that the main elements of this strategy will be in place by February 1996.

Information Services

Freedom of Information

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, membership of the Board and decision making powers are contained 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 Human Services and Health 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

Program Advisory Committees for each of ANSTO's major Program areas 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 Board of Fire Commissioners, NSW State Emergency Services, NSW Environment Protection Authority, NSW Department of Health, Australian Protective Services and ANSTO as well as observers from Sutherland Shire Council and the Nuclear Safety Bureau. It reviews procedures applicable to an accident at the Lucas Heights Research Laboratories 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 with 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 Organisation

The Australian Institute of Nuclear Science and Engineering, an association of ANSTO and 31 universities, arranges access by staff and students of Australasian universities and institutes of technology to the national 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, 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, payroll, 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, drawings, maps and photographs.

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 Australian Nuclear Science and Technology Organisation 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
(ia) in connection with the conditioning, management and storage of radioactive materials or radioactive waste; 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 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.

Subsection 4 (2) of the Australian Nuclear Science and Technology Organisation Amendment Act 1992 (the ANSTO Amendment Act) provides that subject to subsection 4 (3), for the purposes of paragraph 5 (1) (ba) of the ANSTO Act, any radioactive material or radioactive waste that is stored on the Organisation's premises is taken to be radioactive material and radioactive waste arising from the Organisation's activities.

Section 4 (3) of the ANSTO Amendment Act provides that on and after 5 February 1995, the above provision does not apply to any radioactive material or radioactive waste that is the subject of order 3 of the orders made in the Land and Environment Court of New South Wales on 5 February 1992 in the matter of the Council of the Shire of Sutherland v. the Australian Nuclear Science and Technology Organisation.

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.

Facilities for Access

FOI reading facilities can be provided in the Reception and Information Centre at the entrance to Lucas Heights Research Laboratories. Other arrangements for access may be made by communicating with the Manager, Library Services.

Written requests for access to documents under FOI should be addressed initially to:

Mr Raymond Hill
Manager Library Services
ANSTO
Private Mail Bag 1
Menai, NSW 2234, Australia.

The General Manager (Scientific), Director Corporate Services, and Director Information Services have been appointed as authorised officers under Section 23 of the FOI Act.

Health and Safety

The Health and Safety Program is responsible for ensuring a safe and healthy working environment for both ANSTO and CSIRO staff at the Lucas Heights Research Laboratories (LHRL), and the general public in the vicinity of the site. It implements health and safety

policy on site and provides a full range of services in occupational health and safety, radiation protection, medical services, nuclear safety, emergency response, education and training, and risk and reliability engineering.

Occupational Health and Safety

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 reasonably achievable.
- Utilise specialist resources to contribute to national interest projects.

As a result, no member of staff was exposed to a dose greater than 11 mSv (millisieverts), compared to the internationally agreed limit of 20 mSv, and the dose at the 1.6 km buffer zone was less than 1% of the internationally agreed limit for members of the public;

- reviewed and revised the safety assessment system, reconstituted the Safety Assessment Committee and the Reactors Safety Committee with new terms of reference and revised external membership;

Outcomes

The Program:

- ensured that ANSTO's safety systems and policies conformed to best practice as well as complying with statutory requirements in occupational health and safety;
- monitored the radiation exposure of all staff working with radioactive materials and all airborne discharges from the site to ensure that radiation doses were well below internationally agreed limits for both Lucas Heights staff and the public.

- updated and re-issued the ANSTO emergency management plans, provided training for emergency agencies and carried out two emergency exercises in conjunction with the district emergency management officer;

- provided a wide range of services to other Programs and to commercial customers. Particular support was provided in health physics to the project to rehabilitate the former British atomic weapon test sites at Maralinga in South Australia and to the Visiting Ships Panel (Nuclear) in monitoring all visits of nuclear powered warships to Australian ports;

- developed and successfully ran a range of new educational courses, both on site and for commercial customers.

Activities and Outputs

Implementation of Standards and Regulations

Occupational Health and Safety Policy

In compliance with the requirements of the Occupational Health and Safety (Commonwealth Employment) Act 1991, the ANSTO Occupational Health and Safety Policy was published in full in the 1992/3 ANSTO Annual Report. No changes have been made to the policy. ANSTO, through the Executive Director, has actively pursued the continued implementation of all parts of the policy, which is widely distributed throughout ANSTO as Safety Directive A2 'Occupational Health and Safety Policy', issued on 9 March 1993.

Accidents and Incidents

Staff are encouraged to report all incidents and accidents so that investigations can be made and any trends identified. These incidents include 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 have to be reported to COMCARE under the provisions of Section 68 of the Occupational Health and Safety (Commonwealth Employment) Act. In the past year, there were 26 accidents notified and subsequently reported under this Act. Six incidents were classified as serious injury, 17 as extended absences and three as dangerous occurrences, using the categories defined by COMCARE.

Three of the COMCARE classified serious injury accidents involved minor cuts to the hand which required one or two sutures. The remaining three were a fracture to the left foot, an acetone splash to the eye and back pain. All staff are now fully recovered from their injuries.

The three incidents classed as dangerous occurrences were due to maintenance staff working in non-radiological areas. No injuries resulted.

Radiation Protection

As part of the assurance of safety at work for all staff, the ANSTO Personal Dosimetry Service monitored the radiation exposure of 771 persons working at the Lucas Heights Research Laboratories and the National Medical Cyclotron. As well as monitoring external radiation, ANSTO 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.

ANSTO is committed to maintaining a safe working environment and keeping radiation doses as low as reasonably achievable.

The highest effective dose (previously called whole body dose) for the year to any individual was 10.3 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 (whole body) doses for the past three years. Both the average and collective doses continue to decline.

Table 1: Effective Dose

	1992-93	1993-94	1994-95
Maximum effective dose (mSv)	15.4	9.6	10.3
Mean effective dose (mSv)	0.9	0.8	0.7
Collective effective dose (person mSv)	625.0	551.0	548.3

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

doses (mSv)	1992-93	1993-94	1994-95
≤2	614	631	694
>2 to 5	47	71	59
>5 to 10	34	20	16
>10 to 15	2	0	2
>15 to 20	1	0	0
>20	0	0	0

Table 2: Distribution of Effective Doses

A comparison of the maximum and average doses for the past four years is shown in figure 1.

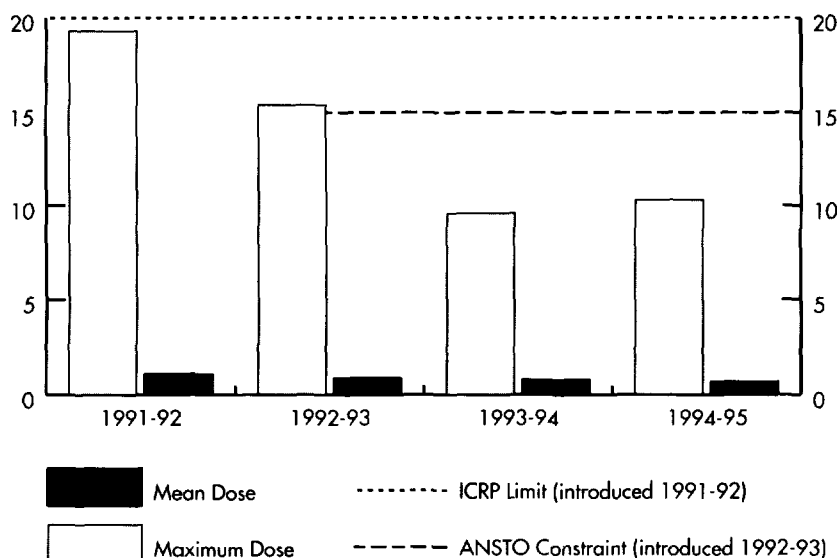


Figure 1: Effective dose

Eighty-two per cent of workers monitored received less than 1 mSv over the year and no worker received more than 11 mSv.

Levels of external radiation at, and in the vicinity of, the LHRL were measured using dosimeters issued by the Australian Radiation Laboratory. The maximum annual absorbed dose to air was 2.13 mSv, measured at a point on the perimeter fence south of the reactor.

Airborne Emissions

Small amounts of gaseous radioactive material are generated by ANSTO facilities. These are treated or filtered before being discharged. All airborne emissions to the atmosphere are constantly monitored. The radiation exposures from these discharges were below the limits set by the International Commission on Radiological Protection (ICRP). The highest cumulative annual radiation exposures resulting from these discharges were 12 µSv (microsieverts) on the LHRL site and 7 µSv at one location

on the boundary of the 1.6 km buffer zone. The dose at the boundary represents less than 1% of the internationally agreed ICRP limit for public exposure. This dose is less than that received during a return flight from Sydney to Melbourne.

Previously, ANSTO operated on an authorisation provided by the NSW Radiological Advisory Council. This role will be transferred to the Australian Institute for Radiation Protection when it is formed. The Australian Radiation Laboratory and the Safety Review Committee are providing an interim service until the new body is operative.

Safety Assessment

All facilities, experiments and processes on the LHRL site with potential hazards require assessment and approval by safety committees. The safety assessment system was reviewed and strengthened during the year, with subsequent changes in the safety committees. In addition to this internal approval system, there are independent external approval and review bodies established by the government to report on ANSTO's activities. These are the Nuclear Safety Bureau, for all issues to do with nuclear plant, and the Safety Review Committee, for all other issues.

Safety Assessment Committee

For all activities not directly involving the reactor, approval is given by the Safety Assessment Committee. The terms of reference, and membership, of the Safety Assessment Committee (SAC) were modified during the year and an external member was appointed. This has given SAC wider representation. During the year, the Committee reviewed some 250 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 that they are implemented.

Reactors Safety Committee

The Reactors Safety Committee (RSC) provides advice to the Executive Director on the safety of nuclear plant, independent of line management and of external safety reviews.

To formulate this advice it may:

- review safety management, proposals for experiments or changes in operations or for modifications to reactors and associated plant operated by ANSTO, which involve safety issues;
- obtain safety assessments from ANSTO staff or from consultants;
- make periodic inspection of the reactors and examine their documentation for adequacy and compliance with Operating Instructions.

The RSC met twice in 1994-95. Three of the eight members of the RSC, including the Chairperson, were external to ANSTO. The Nuclear Safety Unit provided the Secretariat and technical support.

The RSC gave particular attention to:

- the quarterly and annual reports made by the Nuclear Safety Bureau (NSB) to its Minister. The Director of the NSB attended the RSC meetings to discuss these reports;
- the interrelationship between the various components of ANSTO safety management to clarify that all aspects of the safety of ANSTO reactors were being adequately addressed.

In addition to advising the Executive Director, the Chairperson or her delegate attended meetings of the Safety Review Committee to inform it of RSC activities.

Emergency Response

Emergency Arrangements

The Program provides 24 hour emergency response on site, as well as maintaining and exercising the emergency arrangements in conjunction with State agencies.

The Local Liaison Working Parties (LLWP) for LHRL and the National Medical Cyclotron have continued to update emergency response plans as required under the provisions of the NSW State Emergency Management and Rescue Act 1989. Memberships consists of ANSTO, NSW combat agencies and local government representatives, with the relevant District Emergency Management Officers. Observers from the Sutherland Shire Council and the Nuclear Safety Bureau sit on the ANSTO LLWP. Preparation and regular revision of supporting Standing Operating Procedures is conducted by all supporting agencies and relevant sections of ANSTO.

Two emergency response plans exist for ANSTO and were widely distributed throughout Sutherland Shire in November and December 1994. These are:

- the **Lucas Heights Site Emergency Plan** which details ANSTO arrangements for the early detection of, control and coordinated response to, and recovery from any incident or emergency which has only on-site consequences and can be fully dealt with by ANSTO's own resources;
- the **ANSTO Emergency Plan (DISPLAN)** which relates to on-site emergencies which cannot be controlled by ANSTO without assistance from NSW State authorities.

These plans, together with the St George - Sutherland District Disaster Plan (DISPLAN) supersede all provisions of the previous APTCARE document.

The National Medical Cyclotron DISPLAN is complete and will soon be published. Significant progress was made on preparing the Standing Operating Procedures to support this plan.

Emergency Exercises

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

A communications exercise, spread over two days in November 1994, tested communications and call-out arrangements. Key personnel in the Lucas Heights Site Emergency Plan were interviewed to examine their knowledge, understanding and application of the communications and call-out arrangements. External observers included personnel from the Nuclear Safety Bureau and the Safety Review Committee, together with the District Emergency Management Officer. The exercise achieved its objectives and demonstrated the soundness of the emergency arrangements.

A second exercise was held in May to test the evacuation arrangements from the recently completed fenced area surrounding the HIFAR reactor. Among aspects tested during the exercise were the site public address system, the procedures for evacuation to the HIFAR carparks and then to the evacuation centre, and new arrangements for accounting for evacuated persons or locating missing persons. Representatives of the Nuclear Safety Bureau and the District Emergency Management Officer were the external observers. The Standing Operating Procedures were confirmed as appropriate and the behaviour of participants demonstrated a good knowledge of the procedures.

National Interest Activities

Nuclear Powered Warships (NPW)

The Health and Safety Program provides advice and a monitoring service on NPW during the entire period of their visits to Australian ports. Monitoring consists of providing trained staff to set up and operate equipment to measure radiation levels emanating from such vessels and to respond effectively to alarms produced by the monitoring system. Staff would also supervise emergency arrangements in collaboration with State or Territory Governments. Seven ship visits were covered during the year.

A pamphlet on Guidelines for Emergency Personnel and a revised Radiation Monitoring Handbook were produced for the Visiting Ships Panel (Nuclear) for use throughout Australia.

Maralinga

As part of the project to rehabilitate the former Maralinga atomic weapons test site in South Australia, ANSTO provided health physics services for Phase 1 of the project. These services included on-site operational health physics support for people carrying out geological sampling, radioisotope contour measuring and area mapping. Training of staff prior to carrying out work at Maralinga was provided.

All Phase 1 field operations covered by ANSTO were carried out using detailed task-specific work procedures. No person received any significant radiation exposure during these operations.

ANSTO Health and Safety was also contracted to provide detailed written health physics procedures and training notes for Phase 2 operations, the actual rehabilitation work. A Safety Case report was also produced, examining the potential hazards at Maralinga during Phase 2 operations.

Health and Safety

Safety and Reliability Centre Nuclear Safety Unit (NSU)

The Safety and Reliability Centre (SRC) applies and extends ANSTO's safety and reliability analysis techniques to support in-house activities and to support Australian industrial innovation and development. The SRC's activities have contributed to ANSTO's support of government policy making through participation in International Atomic Energy Agency (IAEA) safety and reliability activities.

On-site services during the year have included participation in the revision of the HIFAR Safety Document, assisting the Nuclear Safety Unit in its reviews of HIFAR abnormal occurrence reports, ongoing reliability analysis of HIFAR systems and components, support to Engineering Program with reliability analysis of safety-related system design and modification, and review of safety submissions for experiments with potential major hazards.

Core competencies in nuclear safety are maintained through a research program focused on development of existing technologies and the practical application of these for the benefit of Australian industry. The SRC continued to participate in the development of IAEA safety standards. Collaboration on nuclear safety matters with Indonesian and other overseas agencies continued and the attachment of a Indonesian National Atomic Energy Agency officer on a six month IAEA training fellowship has commenced.

The SRC markets its services commercially through the Australian Centre of Advanced Risk and Reliability Engineering Ltd (ACARRE) - a joint venture with the University of Sydney.

Objectives

Following the review of the ANSTO safety regime, the objectives for the NSU are now to:

- contribute to the development and review of material related to the safety of ANSTO's nuclear plant;
- maintain awareness of developments in safety assessment techniques, safety codes and standards, evolving safety practice, issues and research relevant to ANSTO's nuclear plant;
- advise the Executive Director of matters which require the attention of the Reactors Safety Committee.

Outcomes

The Unit:

- reviewed safety submissions for 15 projects upgrading or modifying reactor plant and buildings, reviewed four sections of the operational and quality documentation, took a major role in revising the HIFAR Safety Document and conducted four safety audits of HIFAR or Moata operation;
- provided Secretariat support to the Reactors Safety Committee and made 12 specific submissions to the Committee;
- demonstrated through a major study of the seismic safety of HIFAR, soon to be published, that, even with a severe earthquake, the plant presents no significant risk to the local community or any resident in the Sydney conurbation;
- in collaboration with External Affairs, provided advice to Government Departments on nuclear third party liability, the Nuclear Safety Convention, the revised Basic Safety Standards, nuclear reactor safety and the nuclear safety programs of the IAEA and OECD/NEA.

Health and Safety

Education and Training

Objectives

To design, develop and deliver:

- useful, relevant and timely education and training programs for ANSTO staff to enable them to operate in an efficient and safe manner; and
- specialist radiation protection and occupational health and safety courses

for Australian industrial, academic, medical and public sector organisations.

Outcomes

- Staff education and training remained a high priority with professional development activities occurring in seven broad areas:

Categories	Number of Courses	Males	Females	Training Days Involved
Computing courses	116	234	71	419
Engineering courses, seminars and conferences (other than HIFAR specific training)	38	58	1	89
Health and safety courses	71	417	96	582
HIFAR specific training courses	14	79	3	380
Management and general administration courses	102	247	114	509
Quality assurance courses	18	100	23	315
Science courses, seminars and conferences	122	175	42	645

Total number of staff days spent on training or attending seminars, conferences or symposia	3 000
Average number of courses attended by males	2.1
Average number of courses attended by females	1.7
Aboriginal and Torres Strait Island staff participating in training programs.	3

Activities and Outputs

The training, accreditation and re-accreditation of reactor staff remained a major activity for ANSTO, as is staff training in health and safety, including radiation protection and emergency response. Major commitments were also made in the areas of quality assurance, computing and administrative skills. Professional development activities included management education and attendance at scientific and engineering courses, conferences and seminars. The Organisation continued its high level of support to staff undertaking approved tertiary courses.

Staff from 115 external organisations either attended scheduled public courses or client specific training programs on radiation protection. A total of 46 radiation protection courses, a nuclear medicine course and four general laboratory safety courses were delivered, ranging from one to 10 days in duration.

Science scholarships totalling \$298 200 were paid to participating universities for undergraduate, postgraduate and Year in Industry students.

The Work Experience Program saw 92 Year 10 students being placed throughout the Organisation. Working with the Rotary Club of Sutherland Shire, ANSTO continued its support of the Young Achiever Program.

Fifty-nine members of local fire brigade units attended one-day information sessions.

Quality

ANSTO has continued developing and implementing quality systems across Programs based on international best practice. The quality systems address the requirements of AS/NZS ISO 9001:1994, which is the Australian and New Zealand endorsement of the International Standard Organisation's standard. Tools for quality improvement are being utilised to maintain ANSTO's safety culture and enhance the quality, efficiency and effectiveness of its processes and products.

Objectives

- To maintain and enhance ANSTO's reputation as a centre of excellence for nuclear research and development.
- To provide confidence that ANSTO's processes are undertaken and its products provided in accordance with statutory and customer requirements.
- To provide confidence to stakeholders that ANSTO's activities are undertaken and achieved in a safe, efficient and effective manner.
- To achieve the objectives of Best Practice through process and product improvements that enhance the quality of ANSTO's activities and products.

Outcomes

- The continued development and implementation of quality systems led to more areas of ANSTO establishing target dates for third party accreditation. These

are areas where such third party accreditation will contribute to meeting statutory and customer requirements for processes or products.

Activities and Outputs

Improvement in understanding of quality management and its objectives continued through induction training, the ANSTO Quality Management course, internal quality system audit courses and other special short courses.

There has been increased utilisation of specific tests, inspections or calibration services, further ensuring high standards in ANSTO services.

Collaboration with the International Atomic Energy Agency continued, with specialist support provided for the development of understanding, use and enhancement of quality management within regional institutions.

ACARRE

(Australian Centre of Advanced Risk and Reliability Engineering)

ACARRE is a joint venture between ANSTO and the University of Sydney which provides a service to government and industry in undergraduate, postgraduate and external education, research, and consulting in risk and reliability. The Executive Director of ACARRE, Professor Tweeddale, is the ANSTO Professor of Risk Engineering at the University of Sydney.

New arrangements for the management of the Centre were implemented towards the end of 1993 and resulted in 1994 being the most profitable year. A new staff member was recruited and is based at the University of Sydney.

ACARRE's core business remains in advising on the risk and reliability of industrial plant producing chemicals and petrochemicals, but there has been increasing demand for peer reviews of reports written by other consultants. The Centre also received a significant number of requests for lectures and seminars across a diverse range of subjects, such as risks from bulk tank storage, project risk management and auditing of major facilities. This is consistent with the objectives of a centre for advanced studies.

The growth of interest in environmental risk was reflected in the development of novel techniques and computer software for quantifying the benefits of risk reduction proposals. A new course on environmental management was introduced at the University and

assistance was provided to government bodies formulating environmental risk assessment methodologies.

At the start of 1995, a hazard appreciation course at the University was made compulsory for undergraduate engineers and during the year a suite of training courses in reliability engineering was developed for the aluminium industry.

Tracerco

Tracerco Australasia is a partnership between ANSTO and ICI Australia Operations Pty Ltd. It is a fully commercial operation whose business is concerned with applying radioisotope technology to solving problems in industrial process plants.

The Company is based at the Lucas Heights Research Laboratories in premises rented from ANSTO, but carries out projects on clients' worksites throughout Australia, New Zealand and South-East Asia.

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

The Company is associated with the international network of ICI Tracerco companies and is responsible for the coordination of Tracerco business in Asia-Pacific. This linkage is important, since many of Tracerco Australasia's customers are multinational companies and references from overseas are valuable in promoting the business in Australia and Asia-Pacific.

In 1994, after five years of continuous and rapid growth, Tracerco achieved its sales budget and realised a modest profit. Although most welcome, that success was based largely upon projects

carried out on behalf of the oil refining sector.

Therefore, in 1994-95, a key objective was to secure a more diverse customer base, covering a broader spectrum of key Australian industries. Useful progress was made. Although oil refining still accounted for 53% of sales, the remaining business was more or less evenly spread among oil/gas production (15%), power utilities (12%), minerals processing (10%) and chemicals (10%). The growth in minerals processing and power utilities applications was particularly pleasing, as these industries were targeted specifically for market development.

Geographically, the business was also much more uniform than in previous years, being spread among NSW (23%), WA (22%), Queensland (18%), Victoria (13%) and SA (15%).

Asian business, at 2% of total sales, fell short of expectations. However, significant promotional effort was directed at Singapore, Thailand and South Korea and it is anticipated that these markets will develop strongly in 1996.

AINSE

(Australian Institute of Nuclear Science and Engineering)

AINSE is now an international consortium of 30 Australian universities and one New Zealand university in partnership with ANSTO. It was established by the Commonwealth Government in 1958 to conduct research into nuclear energy and to provide training in the nuclear field. AINSE's main role today is to facilitate access by University researchers to the nuclear and other special facilities managed by ANSTO through a program of grants and postgraduate awards. AINSE also organises national and international conferences.

AINSE is governed by a Council which consists of representatives of each member University and the Executive Director, the General Manager (Scientific) and the Directors of eight ANSTO scientific and technical Program areas. Most powers of the Council are invested in the AINSE Executive Committee, which consists of three University and three ANSTO Council members. The AINSE President is elected from the University representatives of Council. All projects are peer reviewed by specialist committees which, in general, reflect the ANSTO Program research areas.

A two year review of new arrangements for the AINSE/ANSTO relationship was completed in December. It was concluded that the transfer of the former AINSE scientific and technical staff to ANSTO had resulted in positive benefits for both the staff themselves and University researchers using ANSTO facilities.

The year was also an eventful one for ANSTO with significant implications for AINSE. The major recommendations resulting from the ANSTO Mission Review were presented to the AINSE Council by the new Chairman of ANSTO, Mr Ralph Ward-Ambler, who indicated to Councillors that AINSE was an important and welcome partner with ANSTO.

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. In 1994, income of \$1 766 504 was made up of \$906 000 from ANSTO, \$455 500 from university subscriptions, \$272 342 from external grants, \$102 464 from interest on investments, and \$30 198 from other sources (approximately half from conference registrations). Expenditure in 1994 totalled \$1 442 204, resulting in a net operating surplus of \$324 300. Of this, \$246 629 will be carried forward into 1995 to meet commitments for grants awarded in 1994.

AINSE continues to act as a peak body on behalf of its member organisations in applying for and administering major research infrastructure grants. 1994 was very successful in this respect, with Australian Research Council (ARC) Grants of \$265 000 and \$275 000 awarded in support of Quaternary science utilising the ANTARES Accelerator Mass

Spectrometry (AMS) facility and the National Neutron Scattering facility, respectively. Applications for ARC funding in 1995 have again been successful, with grants of \$265 000 and \$180 000, respectively, awarded for these facilities. This is the third successive year of ARC funding for the AMS facility (the first grant of \$200 000 being awarded in 1993). Neutron scattering was also a major beneficiary under AINSE's first ARC Grant of \$374 000 in 1992 (which also included funds for developing the 3MV and Tandem Ion Beam Accelerators and the 1.3 MeV Electron Accelerator) and a joint AINSE/ANSTO/University of Technology, Sydney, grant of \$250 000 for the construction of the Australian Small Angle Neutron Scattering Instrument's 2-D Area Detector. AINSE had already contributed \$300 000 over three years towards the development of AUSANS.

A total of 165 university projects were supported in 1994 under the AINSE Grant scheme with a further 30 AMS projects funded through the ARC Grant, bringing the total to almost 200. In addition, 16 postgraduate students received AINSE supplements and grants for access to ANSTO's facilities. ANSTO subsidises these awards by providing additional time at no cost to AINSE whilst the students provide valuable support for ANSTO's research. The AINSE Post-doctoral Fellowship scheme was formally discontinued in 1994 with the last of the AINSE Fellows finishing in January.

Two national conferences were held in 1994: the AINSE Nuclear and Particle Physics Conference at Griffith University and the AINSE Radiation Science Conference at the University of Melbourne. A successful workshop on Methods of Quaternary Dating was also held at Lucas Heights. There were approximately 1 600 person-day visits to Lucas Heights by AINSE-supported researchers and 1 200 participant-days at the AINSE Conferences.

Financial Statements

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION STATEMENT OF FINANCIAL POSITION AS AT 30 JUNE 1995

	Note	ANSTO	
		1995 \$'000	1994 \$'000
Current Assets			
Cash	3	24,562	17,517
Receivables	4	2,787	3,236
Inventories	5	5,108	5,808
Other	6	850	569
Total Current Assets		33,307	27,130
Non-Current Assets			
Investments	7	-	11
Inventories	5	645	681
Property, Plant and Equipment	8	145,015	141,192
Total Non-Current Assets		145,660	141,884
Total Assets		178,967	169,014
Current Liabilities			
Creditors	9	1,771	1,217
Leases	10	8	8
Provisions	11	12,473	5,418
Other	12	4,382	4,007
Total Current Liabilities		18,634	10,650
Non-Current Liabilities			
Leases	10	4	12
Provisions	11	9,376	8,313
Other	13	2,531	3,216
Total Non-Current Liabilities		11,911	11,541
Total Liabilities		30,545	22,191
NET ASSETS		148,422	146,823
EQUITY			
Asset Revaluation Reserve	1(f)	55,050	55,050
Fuel Elements Reserve	18	6,500	-
Accumulated Results of Operations		86,872	91,773
TOTAL EQUITY		148,422	146,823

The accompanying notes form an integral part of these statements.

**AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION
OPERATING STATEMENT FOR THE YEAR ENDED 30TH JUNE 1995**

		ANSTO	
	Note	1995 \$'000	1994 \$'000
NET COST OF SERVICES			
Operating Expenses (before abnormal items)			
Research	14	30,428	29,384
Support Services	14	15,731	16,173
Operation of National Facilities	14	14,160	13,950
Corporate Services	14	10,427	9,382
Information Services	14	5,383	5,083
Australian Radiol isotopes	16	7,681	7,926
Total Operating Expenses (before abnormal items)		83,810	81,898
Operating Revenue from Independent Sources			
Research	15	5,845	6,607
Support Services	15	1,980	1,559
Operation of National Facilities	15	2,967	1,952
Corporate Services	15	4,656	4,560
Information Services	15	305	2,238
Australian Radiol isotopes	16	10,876	9,233
Total Operating Revenue from Independent Sources		26,629	26,149
Net cost of services (before abnormal items)		57,181	55,749
Abnormal Items	14 & 15	7,439	1,448
Net cost of services (after abnormal items)		64,620	57,197
REVENUE FROM GOVERNMENT			
Revenues from Government			
Parliamentary appropriations received			
Operating	17	50,339	46,628
Capital	17	15,880	17,589
Total Revenues from Government		66,219	64,217
Operating result		1,599	7,020
EQUITY INTEREST			
Accumulated results of operations at beginning of financial year		91,773	84,753
Total Available For Appropriation		93,372	91,773
Amounts Transferred to Reserves	18	6,500	-
Accumulated results of operations at end of financial year		86,872	91,773

The accompanying notes form an integral part of these statements.

STATEMENT OF CASHFLOWS FOR THE YEAR ENDED 30TH JUNE 1995

	Note	ANSTO	
		1995 \$'000	1994 \$'000
		Inflows (Outflows)	Inflows (Outflows)
CASH FLOWS FROM OPERATING ACTIVITIES			
Inflows:			
Receipts from customers		20,576	20,005
Interest received		1,393	783
Parliamentary Appropriations		66,219	64,217
		<u>88,188</u>	<u>85,005</u>
Outflows:			
Payments to suppliers and employees		(69,353)	(75,501)
Net cash flows provided by operating activities	27	<u>18,835</u>	<u>9,504</u>
CASH FLOWS FROM INVESTING ACTIVITIES			
Inflows:			
Proceeds from sales of property, plant and equipment		52	1,062
		<u>52</u>	<u>1,062</u>
Outflows:			
Property, plant and equipment		(11,834)	(7,927)
Net cash flows provided by investing activities		<u>(11,782)</u>	<u>(6,865)</u>
CASH FLOWS FROM FINANCING ACTIVITIES			
Outflows:			
Principal repayments under finance lease		(8)	(3)
Net cash flows used by financing activities		<u>(8)</u>	<u>(3)</u>
Net increase in cash held		7,045	2,636
Cash at the beginning of the financial period		17,517	14,881
Cash at the end of the financial period		<u>24,562</u>	<u>17,517</u>

The cash balances at 30 June 1995 and 1994 as shown in the Statement of Cashflows are reconciled to the related items in the Statement of Financial Position.

The accompanying notes form an integral part of these statements.

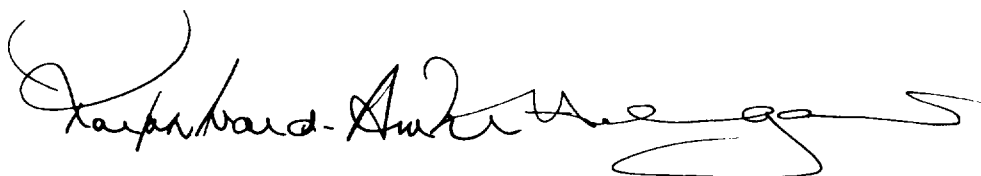
STATEMENT ON BEHALF OF THE MEMBERS OF THE BOARD

In the opinion of the Members of the Board of the Australian Nuclear Science and Technology Organisation, the accounts of the Organisation are drawn up to show fairly -

- i. the operating result of the Organisation for the year ended 30 June 1995,
- ii. the financial position of the Organisation as at that date, and
- iii. the cash flows of the Organisation for the year ended on that date.

The accompanying accounts of the Organisation have been made out in accordance with the Guidelines for Financial Statements of Commonwealth Authorities issued by the Minister for Finance, applicable accounting standards and Statements Of Accounting Concepts (Note 1(a)(ii) refers).

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

A handwritten signature in black ink, appearing to read 'C Ralph Ward-Ambler', followed by a long, sweeping horizontal stroke.

C Ralph Ward-Ambler
Chairman
20 September 1995

Helen M Garnett
Executive Director
20 September 1995

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

1 SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

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

(a) Basis of accounting

The financial statements have been drawn up:

- i. having regard to the provisions of the Australian Nuclear Science and Technology Organisation Act 1987 and the ANSTO Amendment Act 1992,
- ii. in accordance with Guidelines for Financial Statements of Commonwealth Authorities Issued by the Minister for Finance, applicable accounting standards and Statements of Accounting Concepts.

The financial statements have been prepared on the basis of historical costs and do not take into account changing money values, except for certain assets which, as noted, are at valuation. Except where stated, the accounting policies adopted are consistent with those of the previous year.

(b) Cash

For the purposes of the statement of cashflows, cash includes deposits at call which are readily convertible to cash on hand which is used in the cash management function on a day to day basis.

(c) Receivables

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

(d) Inventories

Uranium and Cobalt 60

Inventories of enriched natural and depleted uranium are valued on the basis of net realisable value.

Stock

Reactor fuel, heavy water and stores are valued at average purchase price.

Work In Progress

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

(e) Investments

Investments are disclosed at the lower of cost, less ANSTO's share of accumulated losses, or, net realisable value.

(f) 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 expensed in the year of acquisition.

The cost of assets constructed by the entity include the cost of materials, direct labour and an appropriate proportion of fixed and variable overheads.

Revaluations

Land and buildings are revalued at 3 yearly intervals on the basis of existing use and depreciated replacement value. The most recent valuation was performed as at 30th June 1994 by Mr John Bishop (registered valuer No. 1695) of the Australian Valuation Office.

Depreciation and Amortisation

Items of property, plant and equipment, including buildings, but excluding freehold land, are depreciated over their estimated useful lives 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 year 2000. This is subject to review and the useful life may be extended.

(g) Patents

Due to the current rate of technological change, the commercial value of patents is uncertain, and as benefits to more than one accounting period could not be assured, the cost associated with development and registration of patents is expensed in the year in which incurred unless recoverability is assured beyond reasonable doubt. At 30th June 1995 131 patents (132 at 30th June 1994) were registered to ANSTO.

(h) Employee Entitlements

Wages and Salaries, Annual Leave, Long Service Leave, and General Leave

The provision for employee entitlements to wages, salaries, annual leave and long service leave represents amounts which ANSTO has a present obligation to pay resulting from employee services provided up to the balance date. The provision has been calculated at current wages and salary rates.

Long Service Leave

The provision for long service leave represents the present value of estimated future cash outflows to be made by ANSTO in respect of services provided by employees up to the balance date.

Liabilities which are not expected to be settled within twelve months of the balance date are discounted at 5 percent, a net discount factor determined by the Australian Government Actuary, to take into account those elements that will increase the estimated future outflows attaching to the notional liability and the long term bond rate. In determining the liability for employee entitlements, consideration has been given to future increases in wages and salary rates and the Organisation's experience with staff departures.

General Leave (includes Sick Leave)

ANSTO employees are entitled to non-vesting general leave (inclusive of sick leave), which accumulates with the length of service, but is payable upon valid claims. As not all accumulated non-vesting entitlements will result in future payments, the liability for non-vesting general leave at balance date is that portion of accumulated benefits which is expected to result in future payments to employees. As the general leave taken by employees, assessed on a group basis, is likely to be less than the future entitlements, no provision for accumulated general leave is included in the financial statements.

Superannuation

On behalf of its employees, ANSTO contributes to two superannuation schemes, the Commonwealth Superannuation Scheme (CSS) and the Public Sector Superannuation Scheme (PSS) and meets its liability as costs accrue, on the basis of contribution rates set by the Australian Government Actuary. Based on advice from the Australian Government Actuary in August 1994, ANSTO revised its contribution rates into the two schemes. An amount of \$5,207,164 (1993-1994 \$5,319,294) was contributed during 1994-1995, representing a contribution rate of 26.9% (1993-1994 19.4%) to the CSS and 11.1% (1993-1994 16.4%) to the PSS. These contributions include the Superannuation Productivity Benefit entitlement (3%) and a contribution to the Australian Government Superannuation Trust. These schemes provide benefits in the form of lump sum payments and pensions.

(i) Revenue Recognition

Operating Revenue

Operating Revenue comprises revenue 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 Appropriation

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.

(j) Foreign Currency

Transactions denominated in foreign currency are converted at the exchange rate applicable at the date of transaction. Foreign currency receivables and payables at balance date are translated at the exchange rate applicable at that date. There were no foreign exchange transactions resulting in exchange gains and losses at 30th June 1995.

(k) Income Tax

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

(l) Segment Reporting

The activities of ANSTO, being confined to a single industry and undertaken predominantly in New South Wales, make segment reporting unnecessary.

(m) Economic Dependency

The activities of ANSTO are dependent on the appropriation of monies by the Parliament. Without these appropriations ANSTO would not be able to carry out its functions as prescribed in the Australian Nuclear Science and Technology Organisation (ANSTO) Act.

(n) Consolidation

The controlled entities, Pluteus Limited and Fox Laboratories Limited, are in members voluntary liquidation and have not traded during the financial year. As a consequence, the preparation of group financial statements was not considered necessary.

(o) Comparatives

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

(p) Rounding of amounts

Except where otherwise shown, dollar values are rounded to the nearest one thousand dollars.

2. CHANGES IN ACCOUNTING POLICIES

Employee Entitlements

Employee entitlements have been calculated in accordance with Australian Accounting Standard 30 (AAS 30) for the first time. The adoption of the standard has resulted in a change in the method for calculating the future cost of long service leave and general leave obligations.

Long Service Leave

In the past, ANSTO provided for a long service liability only in respect of employees with more than five years service at current rates. ANSTO now provides for long service leave in respect of all employees, based on the present value of the expected future cash outflows to be made resulting from employees' services, up to the balance date and having regard to the probability that employees as a group will remain with ANSTO for the period of time necessary to qualify for long service leave.

The financial effect of the change is not material and no adjustment has been made to retained earnings at the beginning of the financial year. The financial effect on the current year's operating result and the provision is also not material.

General Leave (includes Sick Leave)

ANSTO paid general leave entitlements on receipt of valid claims from employees but did not provide for the unused portion of the non-vesting accumulated general leave entitlement in its financial statements. The adoption of the AAS 30 standard requires ANSTO to recognise as a liability the portion of the accumulated non-vesting general leave entitlement at balance date which is expected to result in future payments to employees. As the general leave taken each reporting period is less than the entitlement accruing during the period and this experience is expected to continue in future reporting periods, ANSTO has made no provision for the unused accumulated general leave entitlement at balance date. The adoption of the AAS 30 standard has had no financial impact on the 1994-95 financial statements of the Organisation.

3 CASH

Cash at bank, on deposit, and in hand
Cash at bank, trust moneys (Note 12 also refers)

ANSTO	
1995	1994
\$'000	\$'000
23,737	16,561
825	956
<u>24,562</u>	<u>17,517</u>

	1995	1994
	\$'000	\$'000
Trust Moneys	956	856
Cash at the beginning of the year	(131)	100
Moneys received/applied during the year	825	956
Balance of Moneys at end of the year		

4 RECEIVABLES

Current

Trade debtors
Less provision for doubtful debts

2,733	3,170
65	35
<u>2,668</u>	<u>3,135</u>

Advance held by Department of
Industry Science and Technology
for overseas payments
Grants
Other

100	100
-	1
19	-
<u>2,787</u>	<u>3,236</u>

	1995
	\$'000
Age analysis of trade debtors	1,530
Less than 30 days	927
30 to 60 days; and	276
More than 60 days	<u>2,733</u>

5 INVENTORIES

(a) Current Assets

Stores
Reactor Fuel and Heavy Water
Work In Progress

1,011	771
3,508	4,304
108	267
<u>4,627</u>	<u>5,342</u>

Finished Goods
Nuclear materials

481	466
<u>5,108</u>	<u>5,808</u>

(b) Non-Current Assets

Commercial products stock -
Cobalt-60 sources
Nuclear materials

625	661
20	20
<u>645</u>	<u>681</u>

Cobalt-60 sources in process are valued at net realisable value due to extended irradiation time (up to 5 years in some cases) required to bring the Cobalt 60 specific activity to a marketable level.

	ANSTO	
	1995 \$'000	1994 \$'000
6 CURRENT ASSETS - OTHER		
Prepayments	465	475
Interest Accrued	339	94
Other	46	-
	<u>850</u>	<u>569</u>

7 INVESTMENTS

Tracerco Australasia	-	11
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Tracerco Australasia

(a) Under a partnership arrangement with ICI Australia Limited, ANSTO has a 49% interest in this venture. Tracerco is a commercial business concerned with the application of radioisotope technology to the solution of problems in industrial process plants. The business generated a small profit for the financial year ended 30 September, 1994. ANSTO's investment has been disclosed at cost less 49% of the accumulated loss to date.

Australian Centre of Advanced Risk and Reliability Engineering (ACARRE)

(b) In partnership with the University of Sydney, ANSTO operates the Australian Centre of Advanced Risk and Reliability Engineering. ANSTO has a 50% non controlling interest in this limited by guarantee company. The business provides a service to government in the fields of education, research and consulting.

ANSTO has a commitment to the maintenance of the Chair in Risk and Reliability Engineering at the University of Sydney, limited to \$25,000 per annum. During the year, the University did not draw on this commitment. ANSTO has undertaken to assist with a further limited contribution if required.

	ANSTO	
	1995 \$'000	1994 \$'000
8 PROPERTY, PLANT AND EQUIPMENT		
Land at 1994 valuation	33,000	33,000
	33,000	33,000
Buildings -		
temporary buildings at cost	347	347
Less accumulated depreciation	98	89
	249	258
at independent valuation (1994)	49,742	49,742
plus current year additions at cost,	4,352	-
less depreciation	2,163	-
	52,180	50,000
Electrical /Site Services facilities at cost	10,082	8,546
Less accumulated depreciation	2,890	2,171
	7,192	6,375
Plant and Equipment at cost	45,614	39,342
Less accumulated depreciation	22,418	18,746
	23,196	20,596
Plant and Equipment under lease	28	27
Less accumulated depreciation	8	3
	20	24
HIFAR at cost	12,058	11,935
Less accumulated depreciation	9,970	9,448
	2,088	2,487
Synroc pilot plant at cost	10,535	10,536
Less accumulated depreciation	4,565	3,863
	5,970	6,673
Cyclotron facility at cost	17,984	17,902
Less accumulated depreciation	1,761	1,134
	16,223	16,768
Assets under construction	5,146	5,269
TOTAL	145,015	141,192

	ANSTO	
	1995	1994
	\$'000	\$'000
9 CREDITORS		
Current		
Trade creditors	1,380	794
Other creditors	98	128
Externally funded projects	293	295
	1,771	1,217

10 LEASES		
Current	8	8
Non-current	4	12
	12	20

11 PROVISIONS		
Current		
Recreation leave	3,957	4,154
Long service leave	1,098	1,264
HIFAR spent fuel elements *	4,400	-
Waste treatment & disposal **	3,000	-
Licence Fee Amortisation	18	-
	12,473	5,418

* ANSTO has a present obligation for the ultimate treatment, permanent storage, or disposal of HIFAR spent fuel elements. Subject to Government approval, including a decision to fund \$1.66m in addition to funds currently held by ANSTO for this purpose, ANSTO will return in 1995-96, 110 spent fuel elements to the United Kingdom for reprocessing. As a consequence the cost of this proposed shipment has been provided for in the accounts. However the total cost of the treatment, storage, or disposal of all spent fuel elements has not been recognised as the cost cannot be reliably measured at this time. See also Note 1(m) and 23(a).

** ANSTO has a quantity of residual waste from past activities. Using contemporary waste management knowledge and technology, ANSTO has agreed to a program to treat and manage this waste in accordance with best practice principles. See also Note 23(b).

Non-Current

Long service leave	8,805	7,714
Recreation Leave	571	599
	9,376	8,313

12 CURRENT LIABILITIES - OTHER

Accruals	1,791	1,334
Trust Moneys (see also Note 3)	825	956
Revenue received in advance	867	641
Grant creditors	899	1,076
	4,382	4,007

13 NON-CURRENT LIABILITIES - OTHER

Revenue received in advance	2,531	3,216
-----------------------------	--------------	-------

		ANSTO	
		1995	1994
		\$'000	\$'000
14 PROGRAM EXPENSES-Including Abnormal Items			
(excluding ARI - Note 16 refers)			
Salaries		37,905	36,679
Employee entitlements		4,365	4,972
General expenses		8,246	8,097
Stores		6,516	6,448
Maintenance and external services		6,867	7,118
Power and water		1,996	2,307
Reactor supplies		846	1,002
Depreciation		9,101	7,053
Lease amortisation		4	4
Abnormal items	1995	1994	
Write down of investments:	\$'000	\$'000	
- Tracerco	11	70	
- Australian Numerical Simulation and Modelling Services	-	1,378	
Provision for transport and reprocessing of HIFAR spent fuel elements	4,400	-	
Provision for waste treatment and disposal costs	3,000	-	
		7,411	1,448
Other			
Loss on disposal of non-current assets	164	5	
Revaluation of stocks	36	133	
Prior year adjustments	23	48	
Trust disbursements	60	106	
		283	292
TOTAL		83,540	75,420

15 PROGRAM REVENUE

(excluding ARI - Note 16 refers)

Services and contract research	5,081	4,455
Silicon irradiation	2,232	1,312
CSIRO site support	1,230	1,357
Grants	1,861	2,296
Training courses	363	389
Land management	1,449	1,413
Interest	1,370	773
Profit from sale of assets *	376	393
Synchrotron project	402	435
Information technology services	119	1,340
AINSE Interactions	606	640
Other **	664	2,113
TOTAL	15,753	16,916

	1995	1994
	\$'000	\$'000
Proceeds from disposal of non-current assets	956	1009
less written down value of non-current assets	580	616
	<u>376</u>	<u>393</u>

** relates to:

1. Prior year adjustment		
(a) Transfer of funds from closure of ANSAMS	157	-
(b) Write-back of costs relating to the completion of the Plasma Immersion Ion Implanter	165	-
(c) Reinstatement of assets previously written off	108	50
(d) Other	14	-
(e) Reversing notional liability to joint venture partners	-	338
(f) Reinstatement of the Fox Laboratories Limited investment previously written off	-	242
	<u>444</u>	<u>630</u>
2. Assets received free of charge	18	406
3. Other intercompany sales	-	990
4. Unrealised gain from a foreign exchange transaction	-	44
5. Miscellaneous	202	43

16 AUSTRALIAN RADIOISOTOPES - Including Abnormal Items

Australian Radioisotopes (ARI) is a commercial unit within ANSTO. In recognition of this, and to properly assess its performance, ARI accounts are maintained separately from ANSTO accounts.

ARI contribution to ANSTO performance is as follows:

	ANSTO	
	1995	1994
	\$'000	\$'000
Revenue	11,006	9,533
Less intercompany sales	130	300
Revenue from external sales	<u>10,876</u>	<u>9,233</u>
Total expenses (including abnormal items)	12,068	9,255
Less support charges paid to ANSTO	4,359	1,329
Expenses external to ANSTO (including abnormals)	<u>7,709</u>	<u>7,926</u>
less abnormals	28	0
Expense external to ANSTO (before abnormal items)	<u>7,681</u>	<u>7,926</u>

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

Revenue	11,006	9,533
Salaries	3,161	3,009
Other operating expenses	8,763	5,626
Depreciation	144	620
Total Expenses	<u>12,068</u>	<u>9,255</u>
Profit/(Loss)	<u>(1,062)</u>	<u>278</u>

17 PARLIAMENTARY APPROPRIATIONS

	ANSTO	
	1995 \$'000	1994 \$'000
Appropriation		
Act No.1 Operating	49,727	46,628
Act No.2 Capital	15,880	17,589
Act No.3 Operating	612	-
	<u>66,219</u>	<u>64,217</u>

18 Fuel Elements Reserve

ANSTO has agreed to the purchase of 190 HIFAR fuel elements, equivalent to a five year supply, to ensure adequate fuel supplies for continued operation of the reactor. Negotiation of a contract, which will provide for staged delivery of the fuel elements, is at an advanced stage. ANSTO has recognised this proposed obligation by establishing a Fuel Elements Reserve account.

19 CAPITAL AND OTHER COMMITMENTS

Outstanding contracts for equipment, capital works and services at balance date totalled \$8,183,574 and are payable as follows:

Less than 1 year	7,953	4,505
1 to 2 years	231	-

20 REMUNERATION OF MEMBERS OF THE BOARD

Remuneration of Members of the Board is determined by the Remuneration Tribunal and payment is made in accordance with Section 12 of the ANSTO Act 1987.

Included in salaries expenses is remuneration received and/or due and receivable from the Organisation by

- Full time Members of the Board	156	292
- Part time Members of the Board	85	94
	<u>241</u>	<u>386</u>

The number of Members of the Board included in these figures are shown below in their relevant remuneration bands:

Remuneration between	Number	Number
\$Nil and \$9,999	-	5
\$10,000 and \$19,999	3	4
\$20,000 and \$29,999	1	-
\$30,000 and \$39,999	1	1
\$130,000 and \$139,999	-	1
\$140,000 and \$149,999	1	-

21 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 20) who earn \$100,000 or more in connection with the management of ANSTO.

ANSTO	
1995	1994
\$'000	\$'000

1,361	838
-------	-----

Total remuneration received or due and receivable, by executives outside the ANSTO Award

42	228
----	-----

The number of executives whose remuneration for the financial year falls within the following bands:

Remuneration between
\$100,000 and \$109,999
\$110,000 and \$119,999
\$120,000 and \$129,999
\$130,000 and \$139,999
\$140,000 and \$149,999
\$170,000 and \$179,999

Number	Number
4	4
2	-
2	3
1	1
1	1
1	-

22 SUPERANNUATION BENEFITS

Payments to superannuation funds

Annual contributions to superannuation funds, made in accordance with the trust deed and, where applicable, amounts advised by actuaries as being sufficient to ensure the payment of defined benefits to Members of the Board and principal executive officers on their retirement.

ANSTO	
1995	1994
\$'000	\$'000

227	204
-----	-----

23 CONTINGENT LIABILITIES

(a) In addition to the 110 HIFAR spent fuel elements referred to in Note 11, ANSTO has in storage at Lucas Heights a further 1,700 elements. Existing policy for management of spent fuel elements from HIFAR assumes that all of this material could eventually be returned to the United States or sent to the United Kingdom for reprocessing. This policy is currently being reviewed by government. A further provision, which is likely to be significant, will be recognised when a decision by government is known. No further provision for this obligation has been recognised in these Statements as the likely cost of the existing policy, or alternative long term storage or reprocessing options, cannot be reliably measured at this time.

(b) Emerging international standards for the management of radioactive waste require ANSTO to provide for an enhanced program to treat and manage its accumulated residual radioactive waste from past operations. The full cost of this program cannot be reliably measured at this time. However, based on existing quantities and the experience of overseas nuclear facility operators, an initial provision of \$3m has been recognised in these Statements (Note 11 refers).

24 AUDIT FEES

	ANSTO	
	1995	1994
	\$'000	\$'000
Amounts received, or due and receivable, by the auditor for auditing the accounts	95	125

25 INTEREST IN CONTRACTS BY MEMBERS OF THE BOARD

Since 1 July 1994, no Member of the Board has received, or become entitled to receive, a benefit other than a benefit included in the aggregate amount of remuneration received or due and receivable as shown in the Accounts, by reason of a contract made by ANSTO with the Member, or with a firm of which the Member of the Board is a member, or with a company in which the Member has a substantial financial interest.

26 RELATED PARTY DISCLOSURES

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

The Members of the Board during the financial year were:

Member	Appointed	Term Concludes/d
B Ashe (reappointed 02/12/93)	1 January 1993	30 June 1996
C R Ward-Ambler	2 December 1993	30 June 1996
D Williams	2 December 1993	30 June 1996
C Adam	2 December 1993	30 June 1996
A K Gregson	2 December 1993	30 June 1996
D A Hollway	20 December 1993	30 June 1996
H Garnett (Acting)	6 April 1994	5 April 1995
J Bell (Acting)	6 April 1995	10 May 1995
H Garnett (Appointed)	11 May 1995	10 May 2000

Transactions with Members of the ANSTO Board and ANSTO their Member-related entities

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:

Transaction Type	Members Concerned	1995 \$	1994 \$
Provision of services to Cochlear Pty Limited	D Money	-	5,006
Provision of professional services to CRA Limited	J Innes	-	58,465
Sale of goods to Royal Prince Alfred Hospital	J Morris	-	303,830
Provision of services to AMRAD	C R Ward-Ambler	350	-
Sales of goods and services to CSIRO (i)	C R Ward-Ambler, C Adam A K Gregson	1,318,726	1,562,226
Provision of services to Telecom	R Howard	-	2,346
Provision of Contract research to Department of Industry Science and Technology (ii)	D A Hollway	347,236	147,357
Provision of contract research to Cooperative Research Centre for Mining Technology and Equipment	C Adam	175,503	-
Services provided by Prince Alfred Hospital	J Morris	-	10,067
Services provided by CSIRO	C R Ward-Ambler, C Adam A K Gregson	3,816	460,799
Services provided by Department of Industry Science and Technology	D A Hollway	-	2,049
Purchases of goods and services from AMRAD	C R Ward-Ambler	18,592	3,025
Services provided by Labor Council of N.S.W.	B Ashe	-	400
Services provided by Telecom	R Howard	-	609,160
Provision of service by AUSTRADE	D A Hollway	45,125	-
Provision of contract research by the Cooperative Research Centre for Mining Technology and Equipment	C Adam	70,011	-

(i) The amount includes \$1,230,081 (1993-1994 \$1,357,000) being the value of support services provided by ANSTO to CSIRO at Lucas Heights Research Laboratories.

(ii) Contract research work for the Department of Industry Science and Technology, undertaken at cost.

27 RECONCILIATION OF OPERATING RESULT WITH CASHFLOWS FROM OPERATIONS

	ANSTO	
	1995	1994
	\$'000	\$'000
Operating Result	1,599	7,020
(Increase)/Decrease in Receivables	450	(689)
Increase/(Decrease) in Accruals	270	(340)
(Increase)/Decrease in Prepayments	8	(213)
Increase/(Decrease) in Creditors	630	(1,090)
Nuclear Materials Revaluation	(29)	102
Increase/(Decrease) in Employee Entitlements.	702	611
(Increase)/Decrease in Inventories	589	(745)
Lease Interest	(2)	(2)
Foreign Exchange Gain	-	(44)
Assets Received Free of Charge	(42)	(406)
Prior Year Adjustments	(505)	(265)
Finance Lease	8	4
Depreciation/Amortisation	9,249	5,775
(Increase)/Decrease in Accrued Interest	(242)	-
ARI Equity	(805)	(277)
(Gain)/loss on sale of assets	(212)	3
Movement in Investment	11	56
Trade-In on Motor Vehicles	(75)	-
(Increase)/Decrease in Assets Under Construction	(185)	-
Provision-Nuclear Material and Charges	7,400	-
Other	16	4
Net cash provided by operating activities	18,835	9,504



Ref:

**AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION
INDEPENDENT AUDIT REPORT**

To the Minister for Industry, Science and Technology

Scope

I have audited the financial statements of the Australian Nuclear Science and Technology Organisation for the year ended 30 June 1995. The statements comprise:

- . Statement of Financial Position.
- . Operating Statement
- . Statement of CashFlows
- . Statement by Members of the Board, 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 contained therein. I have conducted an independent audit of the financial statements in order to express an opinion on them to the Minister for Industry, 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 whether, in all material respects, the financial statements are presented fairly in accordance with Australian Accounting Concepts and Standards, other mandatory professional reporting requirements and statutory requirements so as to present a view which is consistent with my understanding of the entity's 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 sub-section 29(1) of the Australian Nuclear Science and Technology Organisation Act 1987, I now report that the statements are in agreement with the accounts and records of the Organisation, and in my opinion:

- (i) the statements are based on proper accounts and records;
- (ii) the statements show fairly in accordance with Statements of Accounting Concepts, applicable Accounting Standards, and other mandatory professional reporting requirements the financial transactions and results, and cash flows, for the year ended 30 June 1995 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.



David C. McKean
Executive Director
Australian National Audit Office

For the Auditor-General

Canberra
20 September 1995

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