THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

FINAL REPORT

relating to the

CONSTRUCTION OF NATIONAL MEDICAL CYCLOTRON FACILITY, ROYAL PRINCE ALFRED HOSPITAL, SYDNEY

(First Report of 1989)

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MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

(Twenty-ninth Committee)

Mr Colin Hollis MP (Chairman)
Mr Percival Clarence Millar MP (Vice-Chairman)

Senate	House of Representatives
Senator Bryant Robert Burns	Mr George Gear MP
Senator John Robert Devereux	Mr Robert George Halverson OBE MP
Senator Dr Glenister Sheil	Mr John Graham Mountford MP
	Mr William Leonard Taylor MP *

* Appointed on 29.9.88 following resignation of
  Mr Maxwell Arthur Burr MP

EXTRACT FROM THE VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES

NO. 73 DATED WEDNESDAY 31 AUGUST 1988

22 PUBLIC WORKS COMMITTEE - REFERENCE OF WORK - CONSTRUCTION OF NATIONAL MEDICAL CYCLOTRON FACILITY, ROYAL PRINCE ALFRED HOSPITAL, SYDNEY: Mr West (Minister for Administrative Services), pursuant to notice, moved - That, in accordance with the provisions of the Public Works Committee Act 1969, the following proposed work be referred to the Parliamentary Standing Committee on Public Works for consideration and report: Construction of National Medical Cyclotron facility, Royal Prince Alfred Hospital, Sydney.

Mr West presented a paper in connection with the proposed work.

Debate ensued.

Question - put and passed.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

CONSTRUCTION OF NATIONAL MEDICAL CYCLOTRON FACILITY, ROYAL PRINCE ALFRED HOSPITAL, SYDNEY

By resolution on 31 August 1988 the House of Representatives referred to the Parliamentary Standing Committee on Public Works for consideration and report to Parliament the proposal for the construction of a National Medical Cyclotron Facility at the Royal Prince Alfred Hospital, Sydney.

THE REFERENCE

1. The work proposed is to construct a building at the Royal Prince Alfred Hospital in Sydney to house the national medical cyclotron and associated laboratories and facilities for radiopharmaceutical products. The proposed work includes refurbishment of a nearby patient clinical facility to house a positron emission tomography (PET) camera and a rapid transfer system linking it with the cyclotron building.

2. The estimated cost of the proposed work when referred to the Committee in August 1988 was $8.9m at January 1988 prices.

THE COMMITTEE'S INVESTIGATION

3. The Committee received written submissions and plans from the Australian Nuclear Science and Technology Organisation (ANSTO) and the Royal Prince Alfred Hospital (RPAH) and took evidence from their representatives at a public hearing held at the RPAH on 25 October 1988.

4. The Committee also received submissions and took evidence from the Camperdown Resident Action Group, the Radiation Health Services Section of the New South Wales Department of Health and the Epilepsy Association of New South Wales.

5. Written submissions were also received from the following organisations and are incorporated in the Minutes of Evidence:

- National Trust of Australia (NSW)
- Australian Heritage Commission
- The Council of the City of Sydney
- National Health and Medical Research Council
- Department of Industry, Technology and Commerce
- Professional Officers Association.

6. A list of witnesses who appeared at the public hearing is at Appendix A. The Committee's proceedings will be printed as Minutes of Evidence.

7. Due to the heavy workload of the Committee in late 1988 it was recognised that the Committee would be unable to table its final report on this reference until early in the 1989 autumn sittings. As a result, on 30 November 1988 the Committee tabled a brief interim report informing the Parliament that it would recommend in its final report the construction of the works in this reference.

BACKGROUND

8. Nuclear medicine's full value arises from its unique ability to identify alterations in human physiology before the onset of irreversible structural changes. Nuclear medicine is that diagnostic specialty in medicine which uses small doses of radioactive substances to detect disease states in the whole patient. Patients ingest small doses of radioisotopes either by mouth or intravenously and the radioactivity in localised areas can be measured.

9. Diagnostic and therapeutic nuclear medicine relies on the atoms of any element being made radioactive by irradiation in either a nuclear reactor or a particle accelerator such as a cyclotron. A cyclotron is able to produce a range of radioisotopes for medical application which would be unavailable from a nuclear reactor.

10. The past fifty years has seen the development of a range of radioisotope compounds called radiopharmaceuticals. At present nuclear medicine facilities exist at fifty hospitals throughout Australia and about 200,000 patients annually have a diagnostic procedure involving the use of a radiopharmaceutical.

11. These advances have been complemented by improved detection instruments which not only yield clearer images but also, when used in conjunction with computers capable of manipulating the visual data, are able to provide quantitative data on the dynamic status of an organ. When viewed serially, a sequence of radiopharmaceutical distribution images taken over a fraction of a second apart will visualise an organ as it functions.

12. Although Australian scientists have pioneered many of the diagnostic and therapeutic uses of radioisotopes, Australia lags behind the rest of the developed world by not having a medical cyclotron and the facility to carry out positron emission tomography (PET). There are ninety medical cyclotrons operating in other developed countries. Some developing countries, including Indonesia, are planning to install medical cyclotrons to improve nuclear medicine services.

13. The PET technique allows physicians to undertake advanced studies to improve their understanding and treatment of many of the common disorders which presently incur high social cost. These include stroke, epilepsy, heart disease and certain psychiatric ailments. PET is based on the in vivo detection and imaging of positron-emitting radioisotopes which are introduced as a tracer into the organ or tissue of interest. A positron is a positively charged electron which travels only a few millimetres in tissue and is captured by a negatively charged electron. Both particles are then annihilated and replaced by two gamma rays which leave the point of capture in opposite directions. During administration of a positron-emitting radioisotope the patient is surrounded by a ring of radiation detectors. With the aid of powerful computers, visual images of a series of distribution patterns can be built into a picture of the functional status of the tissue/organ being imaged.

14. PET is already being used:

- to assess the severity of underlying changes in cardiac muscle in patients with heart disease
- to study and demonstrate focal pathophysiology in common conditions such as dementia, stroke and epilepsy
- to assess the response of tumours to treatment
- to quantify blood flow and oxygen and glucose utilisation, related to pathological conditions
- to study the behaviour of drugs in neurology and in psychiatric disorders and the disorders themselves
- to study the normal metabolic pathways involved in sight and hearing.

THE NEED

Benefits to Australian Medicine

15. A cyclotron would provide nuclear medicine departments within Australia with radioisotopes vital to the early diagnosis and treatment of a wide range of medical conditions including cancer, coronary artery disease, stroke and severe trauma. An added benefit is the reduced radiation dose to patients and staff from the use of certain cyclotron products.

16. The PET technique has a unique capability for the study of biochemical and physiological processes, being seen by some as making its greatest contribution in the area of research on both natural body processes and human disease. PET is the best method for selecting the most appropriate epileptic patients for surgical therapy. It can also contribute significantly to the understanding and management of the three leading causes of death in Australia - heart disease, stroke and cancer. PET is also the only technique which can relate brain chemistry to mental

function and hence promises much for psychiatric patients. In the case of hereditary diseases, the high risk patient can be screened and identified years before the symptoms show. PET may therefore provide an important contribution to genetic counselling.

Economic and Strategic Benefits

17. Australian produced radioisotopes would save significant expenditure of foreign exchange while generating revenue in the home market in excess of its annual operating costs. A cyclotron would allow the local production of a range of clinically important short-life radioisotopes which are otherwise unavailable or only partially available through importation at high cost with reduced confidence of continuity. It should also be possible to retain skilled experts who might otherwise have left Australia to work at PET research in other countries (currently estimated at $350,000 per lost medical researcher). The improved management of many diseases should result in more effective treatment, less unnecessary treatment and shorter periods in hospital resulting in net savings in medical benefits payments.

18. The absence of a radioisotope-producing cyclotron means that the Australian community is limited to those nuclear medicines which can be imported from the USA, Europe (including the UK) or Japan. There is a need for reliable access to greater quantities and a larger number of cyclotron-produced radioisotopes. Without a national cyclotron, Australia could lose its position as the region's most advanced country in nuclear medicine technology.

19. The nuclear medicine/PET centre in association with the medical cyclotron would offer the following benefits:

- the centre would form a focus for PET research in Australia, seeking new scientific insight into fundamental biochemical and physiological processes vital to a proper understanding of the physiology of disease

- the centre would have an important training function for physicians, chemists, physicists and technologists employed in nuclear medicine in Australia and the near geographic region

- the centre would evaluate and apply the emerging clinical applications of PET, develop operational and training procedures as well as standards, and disseminate information nationally prior to the widespread deployment of these technologies in Australia. From the operation of the centre there would come first-hand information on how best to plan the introduction of this type of high technology health care.

20. There is no other way of making the short-lived isotopes used in PET studies available to Australian medicine except by the installation of a domestic cyclotron. Australia is too remote from other cyclotrons to permit their regular importation.

COMMITTEE'S CONCLUSION

21. A need exists for a medical cyclotron in Australia in order to produce otherwise unavailable short-lived radioisotopes and to enable their use in conjunction with a positron emission tomography camera. This will enable the proved benefits of these technologies to be offered to a wide range of patients in Australia.

LOCATION AT ROYAL PRINCE ALFRED HOSPITAL

22. The Committee was advised that both the RPAH and the Austin Hospital in Melbourne were considered for installation of the

cyclotron. The reasons for locating the cyclotron at RPAH are as follows:

- the radioisotopes used in clinical PET have very short radioactive half-lives (2 to 110 minutes); consequently, the sites of production and use must be together

- the patients likely to benefit from a PET investigation often require the medical and nursing support found in a general hospital

- RPAH already has a large nuclear medicine department with an international reputation for research and innovation, hence it is an appropriate setting for a national research centre

- ANSTO has the scientific and engineering skills to oversee construction and operation of the cyclotron and the radioisotope production activities. The relative closeness of ANSTO's Lucas Heights Research Laboratories (LHRL) to RPAH ensures the availability of this support

- RPAH, LHRL and Sydney's Kingsford-Smith Airport are conveniently grouped to facilitate an efficient distribution system to all Australian hospitals.

23. At the public hearing the Committee was advised that RPAH and the Austin Hospital had agreed to collaborate fully in the development of patient diagnostic and research activities and had established a collaborative scientific and administrative group to be known as AUSTPAC.

COMMITTEE'S CONCLUSION

24. The Committee is satisfied that Royal Prince Alfred Hospital is the most suitable location for the construction of the national medical cyclotron facility.

THE PROPOSAL

25. It is proposed to establish a national medical cyclotron and a positron emission tomography centre to be operated conjointly by ANSTO and RPAH. The proposal involves the purchase of a cyclotron and associated equipment to be housed in a new building at RPAH. A PET camera will be purchased and installed in a refurbished section of the hospital.

26. Because of the very short radioactive half-life of the radioisotopes used in PET, the medical cyclotron and the PET centre will be linked by a rapid transfer system which will be mainly in an underground tunnel for the 200 metres between the buildings. This will facilitate speedy delivery of the radioisotopes to the point of administration to the patients. The radioisotopes to be made in the cyclotron will complement those already produced by the nuclear reactor HIFAR at the Lucas Heights Research Laboratories.

27. The scope of work comprises the construction of a building to house a cyclotron and associated processing facilities, refurbishment of part of a hospital ward to accommodate the PET camera and an underground transfer system. See Appendices B to E for construction details.

Cyclotron Building

28. The cyclotron building will be bounded on the north by Brodie Street, extending to the southern side of what is now Grose Street, with an eastern boundary 75 metres west of Missenden Road. The total site will occupy an area of approximately 2000 m^2.

29. The cyclotron building will be constructed on land leased at no cost from RPAH which is zoned as 'Special Uses - Hospital' under a local environmental plan. ANSTO will control the facility.

Pet Suite Transfer System

30. It is necessary to transport radioisotopes from their place of manufacture in the cyclotron building approximately 200 metres to the PET suite. There are two major components - namely a pneumatic line with a 'Rabbit' carrier to transport sealed vials, and gaslines for the delivery of radioactive gases. The transfer operations must be rapid as all radioisotopes produced for use in the PET suite have a very short radioactive half-life (2 to 110 minutes. The underground pipework will cross beneath Missenden Road and then rise through shielded ducts to Level 7 of the Albert Pavilion. Radioactive gases such as oxygen or carbon dioxide will pass under pressure through the narrow bore tubing. Other transfers will be made in sealed capsules. See Appendices E and F for construction details and route of transfer system.

Pet Suite

31. The PET suite will comprise a composite floor area to house a PET camera and supporting control and computing equipment. Facilities will be provided for receiving radioisotopes from the cyclotron for radioisotope preparation, for data analysis as well as for patient preparation. The suite will be located on the top floor of the Albert Pavilion and will have a total floor area of 356 m^2. Refurbishment of this floor for the PET suite will allow patients to remain in the hospital environment with its essential life-support infrastructure.

32. As many of the most useful radioisotopes in PET have very short half-lives, often only minutes, the PET camera must be located within a short distance of the cyclotron which produces the substances.

33. The PET camera is some two metres in diameter and weighs about two tonnes and will be located over an existing theatrette. The floor will require strengthening by steel beams. Floor trenches for services to the camera will be installed as well as computer type flooring in the control and computer rooms.

PUBLIC SAFETY AND ENVIRONMENTAL CONSIDERATIONS

General

34. The cyclotron at RPAH will not use uranium or any other transuranic element, it will not rely on the process of nuclear fission for its operation and it will not produce fission product waste substances. The cyclotron will not 'store' large quantities of energy which might conceivably be accidentally released. There is ample evidence that cyclotrons have operated for many years in densely populated cities in other countries without being a cause for public concern.

35. ANSTO gives the highest priority to ensuring the safe operation of its laboratories and nuclear plant. The cyclotron facility will be no exception to this general policy. Further, the installation will be subject to the health and safety regulations of RPAH, the State of New South Wales and the Commonwealth of Australia, as well as those of ANSTO.

36. The cyclotron facility will be registered as an Irradiation Apparatus and as an institution licensed to handle a broad range of radioactive substances, and both the facility and its staff will comply with the licensing requirements of the NSW Radioactive Substances Act.

37. Radiological health and safety measures at the facility will be carried out in compliance with guidelines laid down by the International Commission on Radiological Protection, the National Health and Medical Research Council and according to various State and Commonwealth legislation. Where radioactive substances are to be transported away from the facility, their movements will be controlled under the appropriate national and international regulations. Finally, strategies will be developed to ensure that in the rare event of a radioactive accident, its impact on the environment and public safety will be minimal.

38. ANSTO informed the Committee that the Minister for Industry, Technology and Commerce had advised it that he was satisfied that the cyclotron will not have a significant impact on the environment and that the provisions of the Environment Protection (Impact of Proposals) Act 1974 did not need to be invoked.

39. The extent to which individuals may be irradiated through occupational exposure to ionising radiation is regulated by the standards proposed by the International Commission on Radiological Protection (ICRP) and upheld by Australia's National Health and Medical Research Council. Radiation exposure of members of the general public is controlled by the New South Wales Radioactive Substances Act and associated Regulations.

40. Safety features will be built into the design of the cyclotron facility to ensure that both standards are adhered to under routine operating and accident conditions. The design of these features and the mode of operation will follow the ALARA principle; that is, all radiation exposures shall be kept as low as reasonably achievable, economic and social conditions being taken into account.

41. The design of the cyclotron building has been developed to provide the means for the proper handling and prevention of the uncontrolled movement of the radioactive substances.

42. The Committee was advised that the cyclotron building will be designed with special engineered safety features relating to shielding, ventilation and safety interlocks to protect the staff and the public. The Committee was also advised that the 1.9 metre thick walls housing the cyclotron will protect the public and workers from high radiation levels when the cyclotron is operating by reducing radiation to an acceptable level.

43. RPAH advised that two radiation safety officers are employed at the hospital - one for unsealed and the other for sealed substances. The radiation safety officers also serve on the hospital's biohazard committee and on the workplace safety committee. Nursing staff are supplied with beepers which show peak dosage as well as ongoing dosage.

44. The Radiation Health Services Section (RHS) of the New South Wales Department of Health advised that it would carry out an ongoing monitoring program into filter discharge. At present the filters at Lucas Heights are taken to the Department's facilities at Lidcombe where they are checked and then returned to ANSTO. The Department anticipates that this practice would continue in the new facilities. Inspectors would also be entitled to enter the facilities at any time. Should an accident occur, a report would be submitted to the RHS and then forwarded to the Radiological Advisory Council.

45. ANSTO and RPAH believe that the level of radiation from the PET transfer system, which will be inaccessible to members of staff and the general public, will not be significant and may be discounted as a hazard.

46. The Committee queried the safety implications should a canister become jammed in the tunnel system. RPAH advised that access points at various locations along the route would allow retrieval of jammed canisters.

47. Precautions will be taken to safeguard against possible accidents associated with excavation of the tunnel system. Radiation shielding of the underground conduits will be provided by backfilled earth. Coloured plastic marker tape showing the radiation symbol and contact details will be buried above and directly over the underground conduit to alert excavators to the presence of the conduit.

Laboratory Contamination

48. There is a finite risk from radioactive spills in laboratories where the radioisotopes are chemically processed and where the radiopharmaceuticals are prepared and dispensed. This will be minimised by ensuring that the processing staff are fully trained, aware of the hazards, adopt efficient operating procedures and good housekeeping practices. The projected installation and the plan of operation have been carefully evaluated to ensure the adequacy of radiation protection, both of workers and members of the public.

49. Although considerable attention will be paid to equipment design and operator training in order to avoid the spillage of radioactive substances, these incidents cannot be totally discounted. In the event of such an incident occurring, both the laboratory and monitoring instruments would detect it within a very short time. Remedial steps would be set in train to isolate and confine the spillage. The affected area would be decontaminated by staff specially trained to limit the extent to which the initial spillage could spread.

Transportation of Radioactive Materials

50. The cyclotron products will also be sent to other institutions and hospitals in the Sydney region and throughout Australia. Local destinations will be served by road transport with delivery times of less than two hours; the short half-lives of most of the products will necessitate the use of air transport for distribution interstate and to other parts of New South Wales. In both forms of transport, the consignor is legally responsible for ensuring that the type of packaging satisfies statutory requirements.

51. Tens of thousands of such packages are transported annually by road and air from the Lucas Heights Research Laboratories in a range of appropriate, single-use containers. These containers are constructed with multiple barriers for example a sturdy glass vial, lead shielding pot, shock absorbing packing, sealed steel

can and heavy cardboard carton. This type of containment has the capacity to withstand violent mishandling, dropping and damage by fire.

52. The consequences of a traffic accident involving a radioactive shipment is limited by controlling the quantity of the radioisotope that may be contained within a package and the number of packages allowed per vehicle. Cylcotron radioisotopes have certain inbuilt safety features in that they are usually transported in smaller quantities, have shorter half-lives to avoid any buildup of radioactivty and lower toxicity ratings than their reactor-produced counterparts.

Safe Operation of the Facility

53. Operation of the cyclotron facility and each function and experiment performed in it will be subject to procedural controls at several levels to ensure the maximum safety of the operators, general public and the environment.

54. The building will have only two entrances which will be kept locked at all times. Staff will gain entry with a plastic key card while visitors will be admitted under escort. All radioactive areas will be identified by appropriate written and symbolic signs which can be easily observed and understood. To avoid uncertainties about the extent of a radioactive area, wherever possible the boundaries will be walls, doors, etc. Inside the radioactive areas, places where levels of radiation or contamination levels are likely to be high will be clearly marked.

55. Movement of personnel and goods to and from the radioactive area will be subject to health physics surveillance. Staff will don protective clothing and overshoes when entering the processing laboratories and conduct a personal contamination survey on leaving. All protective clothing will be regularly laundered at the LHRL. The facility will be fully equipped with emergency clothing and equipment which will be checked regularly by health physics staff. Staff and visitors will be issued with

personal dosimeters and film badges. Received doses will be assessed by the Lucas Heights Dosimetry Service and a record kept of individual exposures. No material, equipment or packaged product will be removed from a radioactive area until it has been cleared as being safe by health physics personnel.

56. Closed circuit television cameras will monitor the occupancy of the cyclotron vault and the beam room. There will be a comprehensive system of interlocks to prevent the creation of a hazardous condition by either mechanical or human failure as indicated below.

57. The cyclotron will cease operation if -

- the electrical supply fails or is abnormal
- the ventilation fails or is abnormal
- the cooling systems fail or are abnormal
- the beam is misaligned to cause abnormal radiation levels in vault or beam rooms
- the cyclotron vacuum is abnormal
- the target locking mechanism or cooling system is abnormal
- any of the emergency shutdown buttons located throughout the radioactive area are pressed, or
- the vault or active beam doors are opened.

58. The cyclotron would also not commence operation if -

- the vault door is open

- the neutron shutter is open in the beam room
- the target system is not ready
- the neutron shutter is closed in the beam room
- the door is open in the beam room containing the target to be irradiated.

59. The shielding doors to the cyclotron vault and beam rooms only operate according to set safety procedures; for example the doors can only be closed with two people present and can only be opened if the radiation level in the vault or beam room was less than a preset level.

60. Interlock devices will also protect the mechanisms responsible for moving the targets into and out of the beam rooms and changing the targets on station while an irradiation is proceeding.

61. The hazardous high voltage electrical supply to the cyclotron will be contained in cabinets with automatic shorting *bars which connect the high voltage to ground if a door is* opened.

62. Other systems which will contain safety interlocks include the ventilation control system to guard against fire and over-pressurising, and the transfer pipelines between the cyclotron building and the PET suite. Automatic, fail-safe systems will be incorporated into the cyclotron to minimise the probability that an electrical or mechanical fault will endanger the safety of the operators or the general public.

63. In the event of a power failure, approximately 12 kW of standby electrical power will be available to allow air-conditioners and ventilation fans to continue operation. Self-contained emergency power systems will be provided for local emergency lighting packs, fire alarm panels and emergency exit signs.

COMMITTEE'S CONCLUSION

64. The Committee accepts, on the basis of the evidence provided by the Australian Nuclear Science and Technology Organisation and the Royal Prince Alfred Hospital, that the operation of the cyclotron will not pose any environmental or public risk concerns.

ACCESS FOR THE DISABLED

65. Disabled person access to the cyclotron building will be in accordance with Australian Standards and Australian Construction Services Technical Directives and Guidelines. Access will be provided to the ground floor non-radioactive area and by a personnel lift to the first floor.

STAFF AMENITIES

66. A mealroom, washroom, showers, toilets and a disabled toilet are provided on the first floor. Toilets are also provided in the non-radioactive areas on the ground floor.

67. Fifteen parking spaces will be provided on an interim basis for staff and visitors. Long term plans for RPAH development include a multi-storey car park. The hospital canteen is located 400 metres from the cyclotron building and opens seven days a week. An amenities room in the cyclotron building provides refrigeration and cooking facilities. Public transport consists of major bus routes approximately 400 metres away, as well as railway transport one kilometre away.

HERITAGE

68. Both the Heritage Council of New South Wales and the National Trust of Australia (NSW) were consulted and neither raised objections to the demolition of existing buildings. However both requested that, prior to demolition, a photographic survey be completed and dimensional sketches produced. The

Australian Heritage Commission advised the Committee that it supported this request. ANSTO informed the Committee that RPAH would undertake the survey.

ROAD TRAFFIC ARRANGEMENTS

69. In a submission to the Committee the Camperdown Resident Action Group expressed its concern at the possible closure of Missenden Road which divides the RPAH site. It was particularly concerned at any closure which does not provide an appropriate connection from Parramatta Road to King Street west of Sydney University.

70. RPAH informed the Committee that the cyclotron project itself does nothing to change the traffic patterns that presently exist. It also stated that RPAH, as part of ongoing master planning activities, is undertaking traffic surveys in conjunction with Sydney City Council and Marrickville Council. These traffic surveys will result in alternative traffic management schemes being developed. The Committee understands that there will be involvement of local resident groups to determine precisely what is the most appropriate alternative route for traffic if Missenden Road is closed and the hospital site is consolidated.

ANNUAL OPERATING COSTS

71. ANSTO advised the Committee that the annual operating cost is estimated to be $3m while the likely revenue from the sale of the cyclotron products is estimated to be $2.5m to $3m. The revenue will therefore offset most of the operating cost.

CONSTRUCTION PROGRAM

72. The estimated time for the preparation of contract documents and the invitation and analysis of tenders for the cyclotron building and PET suite and transfer system is eight months from receipt of approval.

73. ANSTO engineering staff will manage and supervise the construction of the cyclotron building as well as the installation and commissioning of major equipment. RPAH planning staff will manage and supervise the construction of the PET facility and the installation of the transfer link.

74. Estimated construction times are:

- cyclotron building - 18.5 months
- PET suite - 8.5 months
- radioisotope transfer system - 10.5 months.

75. The demolition of existing buildings and removal of asbestos is estimated to take three months. ANSTO aims to have the cyclotron operational in December 1991.

LIMIT OF COST

76. The estimated cost of the proposed work is $8.9m at January 1988 prices.

COMMITTEE'S RECOMMENDATION

77. The Committee recommends the construction of the work in this reference.

COMMITTEE'S CONCLUSIONS AND RECOMMENDATION

78. The conclusions and recommendation of the Committee are set out below with the paragraph in the report to which each refers:

		Paragraph
1.	A need exists for a medical cyclotron in Australia in order to produce otherwise unavailable short-lived radioisotopes and to enable their use in conjunction with a positron emission tomography camera. This will enable the proved benefits of these technologies to be offered to a wide range of patients in Australia.	21
2.	The Committee is satisfied that Royal Prince Alfred Hospital is the most suitable location for the construction of the national medical cyclotron facility.	24
3.	The Committee accepts, on the basis of the evidence provided by the Australian Nuclear Science and Technology Organisation and the Royal Prince Alfred Hospital, that the operation of the cyclotron will not pose any environmental or public risk concerns.	64
4.	The estimated cost of the proposed work is $8.9m at January 1988 prices.	76
5.	The Committee recommends the construction of the work in this reference.	77

Colin Hollis
Chairman

2 March 1989

APPENDIX A

LIST OF WITNESSES

ANGLES, Mr A J, Director, Project Planning, Royal Prince Alfred Hospital, Missenden Road, Camperdown, New South Wales

BANKS, Mr G K M, Director, Support Services Division, Epilepsy Association of New South Wales, 468 Pennant Hills Road, Pennant Hills, New South Wales

BARTON, Mr C I, Cyclotron Project Engineer, ANSTO, Menai, New South Wales

BOYD, Mr R E, Project Coordinator, ANSTO, Menai, New South Wales

COOK, Dr D J, Executive Director, ANSTO, Menai, New South Wales

FLEISCHMANN, Mr A, Officer in Charge, Radiation Health Services, Department of Health, PO Box 162, Lidcombe, New South Wales

HORVATH, Dr A G, General Superintendent, Royal Prince Alfred Hospital, Missenden Road, Camperdown, New South Wales

LONG, Dr G, Camperdown Resident Action Group, 23 Fowler Street, Camperdown, New South Wales

MORRIS, Dr J G, Head, Nuclear Medicine Department, Royal Prince Alfred Hospital, Missenden Road, Camperdown, New South Wales

SMITH, Dr R, Deputy Executive Director, ANSTO, Menai, New South Wales

CYCLOTRON BUILDING

Scope of Work

The building will contain a number of functional areas such as: cyclotron vault where the cyclotron and the PET radioisotope targets are located, beam room where radioisotope targets are located, radiopharmaceutical production laboratories, quality control laboratory, bioassay laboratory, health physics laboratory, packaging and despatch areas and administrative and staff areas.

The building will comprise a basement (60 m^2), ground (1414 m^2) and part first floor (654 m^2 offices, 263 m^2 plant room) and have a total floor area of 2391 m^2. The basement will be used for the storage of incidental radioactive parts and treatment of radioactive liquid wastes. The ground floor will house the cyclotron and beam room plus a number of functional areas such as the radiopharmaceutical production laboratories, quality control laboratories, bioassay laboratory, aseptic production laboratory, workshop, control room, power supply room, health physics laboratory, stores, packaging, despatch, reception and toilets. The first floor will comprise offices, staff amenity areas and the plant room.

Preliminary works include the rearrangement of existing roads, relocation of services, demolition of obsolete buildings and preparation of the building site. No private residences will be demolished. General works will include the provision of a car park and landscaping of the surrounding area.

CONSTRUCTION DETAILS - CYCLOTRON BUILDING

A foundation investigation, by drilling a series of cored holes, has revealed reactive clays and has necessitated a pier and beam footing design. Piers of 1 metre diameter, 5.2 metres deep will be founded through the reactive soil layer to bedrock. Framing of the building is conventional column and beam construction.

Face brick external walls will be cream in colour, similar to the adjoining King George V Memorial Hospital with red face brick dado and string courses picking up the banding effect of the nearby Albert Pavilion.

Windows will be powder coated aluminium, framing tinted glass to the radioactive area and clear glass with external sun control to the non-radioactive areas.

Because the roof of the building will be visible from the adjoining buildings, a silicone modified polyester painted steel tray roof sheeting has been selected over the plant room and first floor offices, supported by steel beam and purlins. The external area at the first floor level will be trafficable and covered by a butynol waterproof membrane fixed over a reinforced concrete slab.

Special consideration has been given to the location and acoustical isolation of the plant room to prevent unacceptable noise and vibration. The plant room will house mechanical, electrical, cooling, air-conditioning and ventilation equipment. Access to the plant room will be restricted to authorised personnel only.

Building Materials and Finishes

Well proven materials and construction techniques have been selected.

Internal wall and ceiling finishes in the radioactive areas will be non-absorbent, non-fibre shedding, smooth and readily cleanable with low flame spread/smoke developed indices. Floor finishes to the laboratories will be seamless welded sheet vinyl coved 100 mm up the walls. Floor finishes to the cyclotron vault, beam room, workshop and waste store will be epoxy painted concrete to provide a durable, impervious, washable, slip resistant surface.

Internal wall finishes to the non-radioactive areas will be painted gyprock, except in the areas of heavy traffic, where painted cement rendered brickwork will be used. Floor finishes to the office areas will be commercial quality carpet with the remainder of the non-radioactive area floor finished in either welded sheet vinyl, carpet, ceramic tiles, quarry tiles or epoxy painted concrete as appropriate. Ceiling finishes to the office areas will be a false ceiling employing a two-way grid with acoustic tiles. The foyer ceiling will be finished in plasterboard and will feature a roof light. A computer floor will be fitted to the control room and power supply room.

The 1.9 metre thick reinforced concrete walls and roof to the cyclotron vault and beam room will be normal density concrete, but using crushed limestone aggregate which has very low sodium content (less than 0.2%) to reduce the residual radiation background when the cyclotron is not in operation. Reinforcement steelwork will also be placed deeper than normal below the surface of the interior walls of the vault and beam room to minimise radiation background due to the production of cobalt-60 and iron-59. This selection of construction materials and design techniques is based on overseas experience.

Mechanical Services

In the design of the cyclotron building, careful consideration has been given to the design of the mechanical services to provide facilities for the safe handling of radioactive substances. To prevent accidental releases of radioactivity, the facility has been designed on the principle of double containment.

The interior of the entire building, excluding the plant room, will be air-conditioned and none of the windows will be openable, other than for cleaning purposes. The radioactive area will always operate under negative pressure so that air leaks inwards; the air within this area will be changed at least 10 times per hour and exhausted through high efficiency particulate air filters and charcoal beds to a discharge stack. The filter banks will be fitted with monitors and linked to the control room to detect when the filters require replacement.

Chemical processing will be performed within totally enclosed steel chambers which are surrounded by a further shell of lead. These are usually called 'hot cells' a term which refers to their radioactive interiors rather than to temperature. The hot cells will also be maintained at a negative pressure by a separate ventilation system which exhausts the air into the main extract ventilation system for the radioactive area.

Before discharge to the atmosphere, the concentration of radioactivity in the air drawn from the hot cells is further reduced by dilution with the exhaust ventilation from the entire building. The exhaust air will be continuously tested for radioactivity as it is discharged to the atmosphere. The level of radioactivity will be continuously recorded. Inlet air to the building will be remotely located in respect to the outlet flow. This precaution is taken to prevent recycling.

The levels of radioactive material discharged will be below the limits specified in the NSW Radioactive Substances Act and associated Regulations; emissions will be subject to independent monitoring by the Radiation Health Services of the NSW Department of Health.

Computer grade air-conditioning will be provided to the cyclotron power supply room and control room.

Liquid wastes generated within the cyclotron facility will be segregated according to origin. Low-level radioactive liquid waste such as cleaning solutions, wash water from the sinks, etc., will be directed into one of several large delay tanks located in a basement of the facility. When one tank is full, it will be isolated and another one brought into use. The contents of the first tank will be discharged to the sewer as trade waste following monitoring to confirm that the levels are below the limits set by the NSW Department of Health on the advice of the NSW Radiological Advisory Council. The discharges will be monitored by the Metropolitan Water Sewerage and Drainage Board.

Small quantities of medium-level radioactive liquid waste are also expected to arise from the chemical processing of the radiopharmaceuticals. These will be stored in sealed containers in the basement area until the radioactivity has decayed to the point where they can be treated as low-level waste.

Liquid waste from the non-radioactive areas of the building will be connected to the sewer mains and be completely independent from the radioactive liquid waste system.

Solid radioactive waste produced in the facility will be of low specific activity and small in volume. It will be packed according to the requirements of the NSW Radioactive Substances Act and transported in a secure manner to Lucas Heights by an ANSTO vehicle.

Ancillary mechanical services including compressed air, nitrogen and vacuum will be provided to the laboratories, beam room and cyclotron vault.

Electrical Services

Electrical demand by the cyclotron (120 kVA), associated equipment and building services will require the upgrading of the electrical power supply system by the installation of a 750 kVA transformer which will be sited in the perimeter wall to the service courtyard.

Standby electrical power is required for the exhaust ventilation fans which will run continuously (until manually stopped) after a power failure. The estimated standby electrical power requirement is 15 kVA which will be provided from the existing RPAH system which has sufficient supply capacity to meet this additional demand.

All other emergency power requirements are self-contained in such items as local emergency lighting packs, fire alarm panels, emergency exit signs, security alarm system, etc.

For personnel protection, power circuits in wet areas will be fitted with earth leakage circuit breakers and each laboratory will be provided with emergency switches for isolation of its circuits.

Lifts

A passenger lift will be provided between the ground and first floor for disabled persons. A goods lift will also be provided between the basement waste store and ground floor loading dock.

Fire Protection

Passive fire protection will comprise fire rated materials and exits complying with the requirements of codes and ordinances.

Active fire protection to be controlled by a central control room fire alarm panel will comprise the following:

- HVAC duct smoke detection and controlled shutdown of plant
- specialised Halon 1301 fire suppression within the cyclotron vault and beam room with controlled shutdown of plant
- automatic water sprinklers in laboratory and hot cell areas
- fire detectors in remaining areas.

Hand held extinguishers will be provided in specific locations.

APPENDIX D

PET SUITE - CONSTRUCTION DETAILS

Scope of Work

The PET suite will comprise a composite floor to house a PET camera and supporting control and computing equipment. Facilities will be provided for receiving radioisotopes from the cyclotron, for radioisotope preparation, for data analysis as well as for patient preparation. The suite is to be located on the top floor of the Albert Pavilion and will have a total floor area of 356 m^2.

Refurbishment of the existing facilities is required to meet the new needs and will complement hospital plans for refurbishment of the entire top floor to house the RPAH Department of Nuclear Medicine.

Building Structure

The PET camera is some two metres in diameter and weighs about two tonnes and will be located over an existing theatrette. The floor will require strengthening by steel beams. Floor trenches for services to the camera will be installed as well as computer type flooring in the control and computer rooms.

Building Materials and Finishes

Well proven materials and construction techniques will provide appropriate structural, thermal and acoustic performance. Internal materials will generally follow conventional practice with smooth finishes to walls and ceilings and welded sheet vinyl flooring. Service areas will have a waterproof, non-slip finish. Particular attention will be paid to the detailing of support areas to allow ease of cleaning and safe disposal of wastes. Specialised construction and finishing techniques will be used in areas having specific functional requirements such as floor trenches and computer room access floors.

Mechanical Services

Mechanical services will be provided in accordance with relevant codes, regulations and requirements of statutory authorities. The suite area will be generally air-conditioned with attention being paid to the special needs of the electronics cabinets. A pneumatic line receiving station for the receipt of the vial containing the radioisotope will be provided with all necessary supports to enclose the station on all sides with 50 mm thick lead blocks. A fume cupboard and fume exhaust system will be provided for the receipt of gaseous isotopes with sufficient strength to support a 50 mm thick lead brick wall along the front and side walls. The fume exhaust system will discharge above roof level in accordance with State Pollution Control Commission guidelines. Liquid wastes will be treated as required to ensure all wastes entering the sewer system meet the required standards.

Electrical Services

415 volt three phase, 100 kW power will be supplied from the existing electrical distribution within the building. Dedicated power circuits will be provided to specific items of equipment. Elsewhere, outlets will be in accordance with standard hospital and office accommodation.

Lighting levels will meet the relevant Australian Standard but will blend with a serene environment for the patients. Additional provisions will be made to meet specific requirements for task lighting. Energy efficient fluorescent luminaires will be used throughout and supplemented as appropriate with incandescent luminaires. Glare control diffusers will be provided where required such as over video screens. An emergency evacuation lighting system will be provided in accordance with the relevant codes and standards. Telecom block-cabling will be provided and additional duct space will be made for computer and data cabling.

Hydraulic Services

Adequate town water, sewerage and drainage systems exist in the building. Services will include hot and cold water to basins, showers and fittings. Sewerage and drainage facilities will be provided as required.

Building Fittings

The building works include all fittings and fixtures forming an integral part of the building such as light fittings, carpets, sanitary fittings, laboratory benches and storage shelves. Loose furniture, furnishings and equipment are included.

Fire Protection

Passive fire protection will comprise fire rated materials and exits complying with the requirements of codes and ordinances. Active fire protection will include an automatic fire detection system, fire hose reels and hand held extinguishers.

Planning

Coordination of the construction activities are an important feature to ensure the minimum possible disruption to existing hospital services. The construction works will be overseen by the Planning Department of RPAH.

APPENDIX E

PET SUITE TRANSFER SYSTEM

Scope of Work

The 'Rabbit' carrier transport system is of the classic well-proven pneumatic shuttle type which is a modern version of the pneumatic money transfer systems commonly used in department stores about 40 years ago. The send station is in a laboratory in the cyclotron building and the receive station is in the PET suite. The gaslines are stainless steel capilliary bore tubing (1 mm internal diameter) with a receiver station in the PET suite fume cupboard.

Route

The pneumatic line, gaslines and electrical control communications links will share a common underground conduit from the cyclotron building to the PET suite. The route will be as shown in Figure 1 and will be subject to the formal lodgement of an easement to the Land Titles Office.

Control and Monitoring

Electrical controls and status monitors are to be provided that will confirm the status of the system before transfers, the passage of the transfer and also confirm that transfers have been satisfactorily accomplished. Audio communications between the send and receive stations will also be provided.

Planning

Detailed scheduling will be undertaken at the commencement of the construction stage to minimise possible disruptions, particularly across Missenden Road. The construction works will be overseen by the Planning Department of RPAH.

APPENDIX F

PROJECT DRAWINGS

Figure

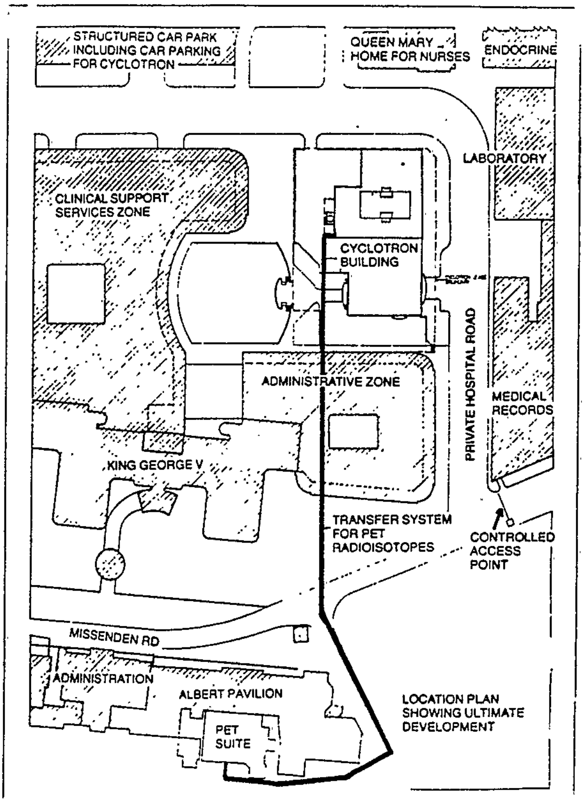
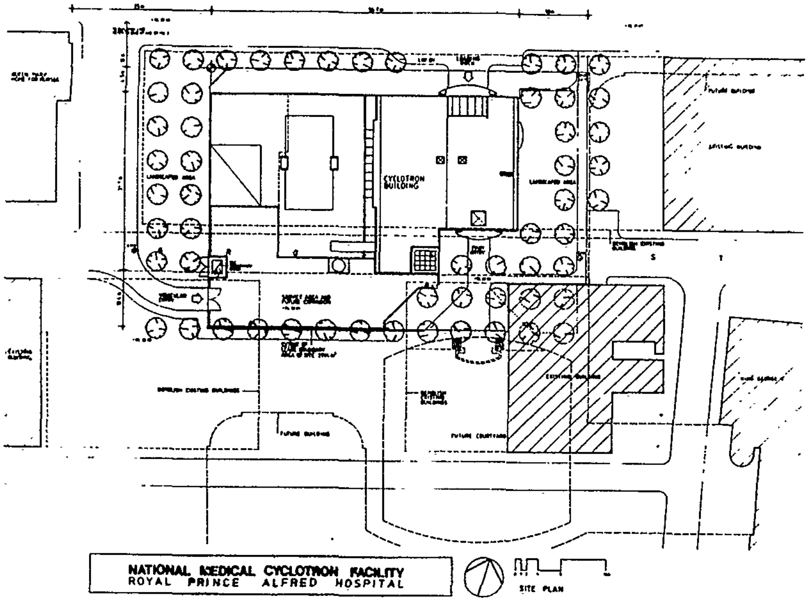


FIGURE 1 ROUTE OF PET TRANSFER SYSTEM



NATIONAL MEDICAL CYCLOTRON FACILITY
ROYAL PRINCE ALFRED HOSPITAL

FIGURE 2 SITE PLAN

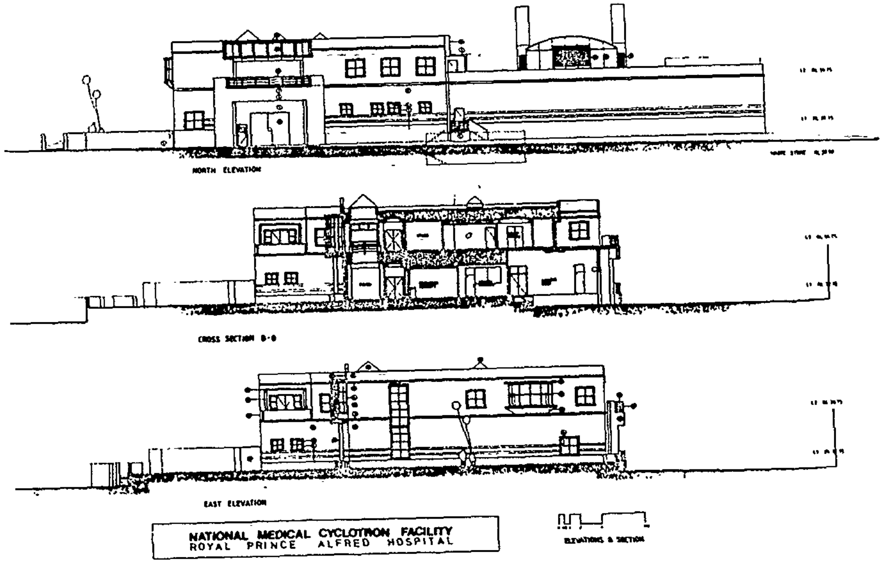


FIGURE 3 ELEVATIONS AND SECTION - NORTH AND EAST

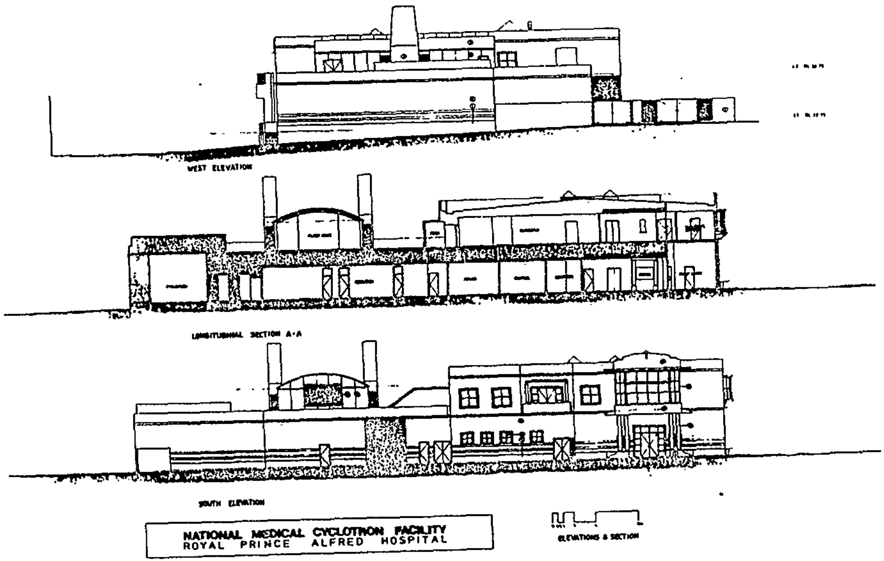


FIGURE 4 ELEVATIONS AND SECTION - SOUTH AND WEST