Australian Government

Nuclear-based science benefiting all Australians

**Supplementary Submission No. 1.2**
(ANSTO Facilities)
Date: 14 May 2010

# SUPPLEMENTARY SUBMISSION TO THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

# PROPOSAL FOR A NEW CENTRE FOR ACCELERATOR SCIENCE (CAS)

## MAY 2010

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION
New Illawarra Road, Lucas Heights (Locked Bag 2001, Kirrawee DC NSW 2232) T +61 2 9717 3111 F +61 2 9543 5097
www.ansto.gov.au

## Table of Contents

## 1. Background

1.1 On 9 April 2010, at the public hearing for the Public Works Committee (PWC) *Inquiry into the Proposed Construction of a Centre for Accelerator Science and extensions to other facilities for the Australian Nuclear Science and Technology Organisation (ANSTO),* it was noted that the siting location and the design concepts for the Centre for Accelerator Science (CAS) had not yet been finalised by ANSTO. The Committee resolved that it was unable to make a determination on ANSTO's CAS submission until those decisions had been made. The Committee requested that ANSTO complete its process for siting location and design concept for the CAS and report back to the Committee.

1.2 After further costing and designs were developed, ANSTO's Capital Investment Committee, chaired by ANSTO Chief Executive Officer, Dr Adi Paterson, carefully considered each option and ANSTO has now come to a strategic and cost effective decision regarding the siting and design of the CAS.

1.3 This document is supplementary to ANSTO's original submission titled "Proposal for a New Centre for Accelerator Science" referred to the Public Works Committee on 25 February 2010. It presents ANSTO's chosen site and design concept for the proposed CAS. This document does not seek to reproduce all elements of the original proposal. Rather, it will draw to the Committee's attention elements of the original proposal that are now elucidated or superseded as a consequence of the site and concept design selection.

1.4 At the hearing on 9 April, ANSTO also undertook to provide the PWC with further information regarding benchmarking against other similar facilities. This information is presented in Section 3 of this document.

## 2. Description of the Proposal

### 2.1 Scope Finalisation

2.1.1 The vision for the CAS is to create a nexus of scientific expertise and research innovation around the drawcard of state-of-the-art accelerators and sample preparation facilities at ANSTO. This will be achieved by optimally siting the new facilities in order to maximise workflow benefits and synergies from existing ANSTO infrastructure, and designing it in such a way that future growth and expansion in accelerator science is allowed for.

2.1.2 On April 9, when queried about building costs, Professor Dodson advised that 'we are not yet in a position to work out whether the total facility we are looking for will fit within the budget, and we will not know that for about another week'. Following detailed costing of the proposed scope by a quantity surveyor, it was realised that the total facility scope being envisaged did not fit within the budget available.

2.1.3 Consequently, some scope reductions have been required. These include: rationalisation of the accelerator hall and related facilities; utilising existing offices and amenities where possible; and not incorporating the radiocarbon-related chemistry laboratories and offices in the scope at this time, by maintaining some of the existing facilities at ANSTO (laboratories and offices in Building 16). The design of the chemistry facility will however make provision for this scope to be realised in the future and it is detailed on the overall site-wide master plan. It is also worth noting that there was no significant difference in cost between the two siting proposals presented to the PWC on 9 April.

2.1.4 The components for the new CAS facility subject to PWC consideration are:

a) The accelerator hall and associated plant rooms, control room, technical work areas and user laboratories. Total proposed floor space required 1986 square metres.

b) The Accelerator Mass Spectrometry (AMS) Chemistry laboratories - sample preparation laboratories required for AMS analysis on the accelerators. This will include sample processing and analytical laboratories, chemical and sample storage for:

- Cosmogenic isotope analysis such as Beryllium-10 and Aluminium-26, including labs for crushing of geological samples, chemical separation and purification.
- Actinide, iodine and chlorine analysis, including chemical separation and purification
- Technique development and chemical processing of other sample types as found to be required for future research programs.
- Designated Quarantine premises for the initial treatment of samples from overseas.
- Office space and common areas for the staff working in these laboratories.

Laboratories for preparation of samples for radiocarbon analysis are now not included due to the required scope reduction. Total proposed floor space required 912 square metres.

c) Uranium Series Laboratories (USL) – State of the art clean room facilities for ultra sensitive isotopic analysis by mass spectrometry, including a Thermal Ionisation Mass Spectrometer (TIMS) and other instrumentation. Total proposed floor space required 394 square metres.

Tables showing the detailed floor space requirements, resulting from scope reduction, are included in **Attachment A**.

**2.2 Site Finalisation**

2.2.1 Three siting options for location of the CAS facility were listed in the original submission (Sections 2.3 and 2.4). Two of these options were excluded, prior to the Public Works Hearing on 9 April, on the basis that they were not able to meet the requirements for the facility,. The two siting options presented to the PWC on the 9 April visit comprised one of the original suggestions (entire CAS facility adjoined to ANTARES facility) and a combined approach, which had been developed in the interim between submission and the hearing (separate buildings and sites for accelerator hall and chemical laboratories building). Summaries of the other three options and the basis for their exclusion are provided in **Attachment B**.

2.2.2 Since the Public Works Committee Public hearing on 9 April 2010, ANSTO has developed further costings and designs for the two options presented. ANSTO's Capital Investment Committee, chaired by ANSTO Chief Executive Officer, Dr Adi Paterson, carefully considered each option and has now come to a strategic and cost effective decision regarding the siting and design of the CAS. The site selection process included review of the site master plan for the surrounding area, adjacent buildings and roadways, and employee traffic flow between these facilities, in conjunction with the long term master planning of the precinct.

2.2.3 The site option selected separates the 'Accelerator Hall' and the 'Accelerator Mass Spectrometry (AMS) Chemistry and Uranium Series Laboratories' into two separate buildings.

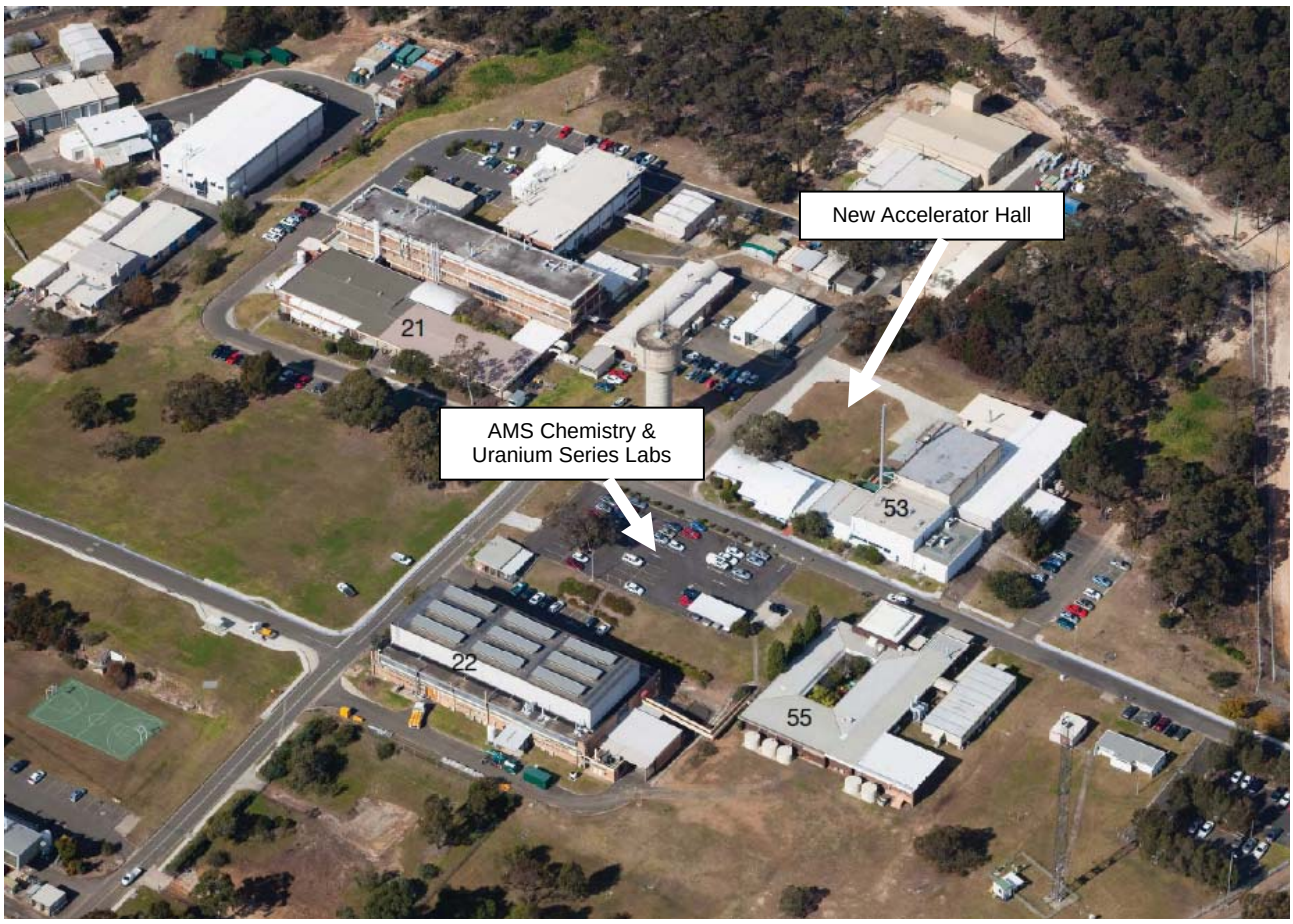



**Figure 1 General location of proposed site, showing the existing ANTARES accelerator facility (Building 53), the STAR accelerator facility (Building 22) and the Institute of Environmental Research (Building 21).**

2.2.4 The 'Accelerator Hall' is to be located behind the existing ANTARES accelerator building (Building 53) without the need for any demolition to existing facilities. Accelerator service laboratories will adjoin the accelerator hall to the south.

2.2.5 The 'AMS Chemistry and Uranium Series Laboratories' will be constructed on the existing carpark site opposite the new 'Accelerator Hall' and lying between the existing facilities housing the STAR and ANTARES accelerators (Buildings 22 and 53). The location where the new facilities are proposed can be seen on Figure 1.

2.2.6 These laboratories will be constructed initially as a single storey building with some plant rooms above, whilst provision will be made for future expansion to the east and above the laboratories as a second storey. The scope for the chemical laboratories has been reduced in comparison to that outlined in the original submission and addressed in section 2.1.4 above.

2.2.7 Designing and siting in this way ensures that provision is made for future growth requirements. In particular, the foreseeable necessity to eventually replace ANSTO's existing radiocarbon sample preparation laboratories (Building 16) and incorporate them into the 'AMS Chemistry and Uranium Series Laboratories. This future expansion is subject to the availability of funds. The concept for future expansion is that the ground floor will generally be dedicated to laboratory space and the second floor would house both offices and plant rooms.

2.2.8 The architecture of the new facilities will complement the existing site environment, but be executed in such a way to create an identifiable and recognisable Centre for Accelerator Science.

**2.3 Site Selection Basis**

2.3.1 This siting location was chosen for the following reasons:

a) it allows optimisation of existing facilities and services;
b) it enables simultaneous irradiation experiments with two accelerators (ANTARES and the new 6 MV tandem accelerator) by allowing access to the ANTARES target hall from the new 6 MV accelerator;
c) it centralises infrastructure for operational staff by having ANTARES and the two new accelerators in close proximity;
d) it allows space for possible expansion, consolidation and possible future accelerator beam lines;
e) it enhances the 'Centre for Accelerator Science' vision by creating a precinct of associated facilities in close proximity; and

2.3.2 Additional factors that lead to the decision for two buildings on the chosen sites are:

a) Ground floor areas for laboratories are optimised. In particular, ground floors in the Chemistry Laboratories are needed for:
    (i) heavy equipment, such as the thermal ionisation mass spectrometer in the Uranium Series Laboratories;
    (ii) vibration isolation of the rock crushing laboratory;
    (iii) safer and lower cost delivery of dangerous goods (acids, liquid nitrogen, gases) which are required in several areas; and
    (iv) delivery of large rock and coral samples.
b) The accelerator hall must be on the ground floor due to the heavy equipment; the accelerator hall is a large separate light weight superstructure that does not facilitate multi-storey construction.

c) This ‘ground floor’ arrangement eliminates the need for a dangerous goods lift for the Chemistry Laboratories.
d) The new accelerator located in an extension to Building 53 provides the possibility for simultaneous beam experiments in the future.
e) Locating the new building for AMS Chemistry on the existing car park creates natural linkages between the associated activities in the STAR and ANTARES Buildings (Buildings 22 and 53). This produces a research precinct with improved opportunities for personnel interaction. By creating a pedestrian area with car parking moved to the edge, the work environment is made more attractive and safer.
f) Other lots available did not fulfil the entire CAS scope, and did not offer suitable width for future expansion of laboratories and offices.

**2.4 Associated plans**

2.4.1 Facility design documents are currently being developed to meet the requirements of the design principles. This is being carried out by architectural design consultants under a preliminary design work scope. The latest reference plans are shown in Figure 2, below.

**2.5 Facility Impact on Existing Car Parking**

2.5.1 Availability of car parking is already being considered by ANSTO as part of the overall site master planning initiative. A traffic management working group is in place, reporting to the infrastructure committee, and currently investigating the requirements across the Lucas Heights Site against what is currently available.

2.5.2 This is not an isolated issue for the CAS project as there are a number of new infrastructure projects planned across site (including the OPAL & Bragg extension projects) that affect car parking, general traffic management, and the overall site master plan.

2.5.3 The plan is not to address the CAS car parking in isolation, but to take a holistic view to address the future car parking requirements across the entire ANSTO site. This may eventuate in consolidated parking for all of ANSTO at the centre of site, outside the site, or around the perimeter of the Lucas Heights site. This would then promote other green initiatives being investigated by the recreation/green corridor working group under the same site master planning initiative.

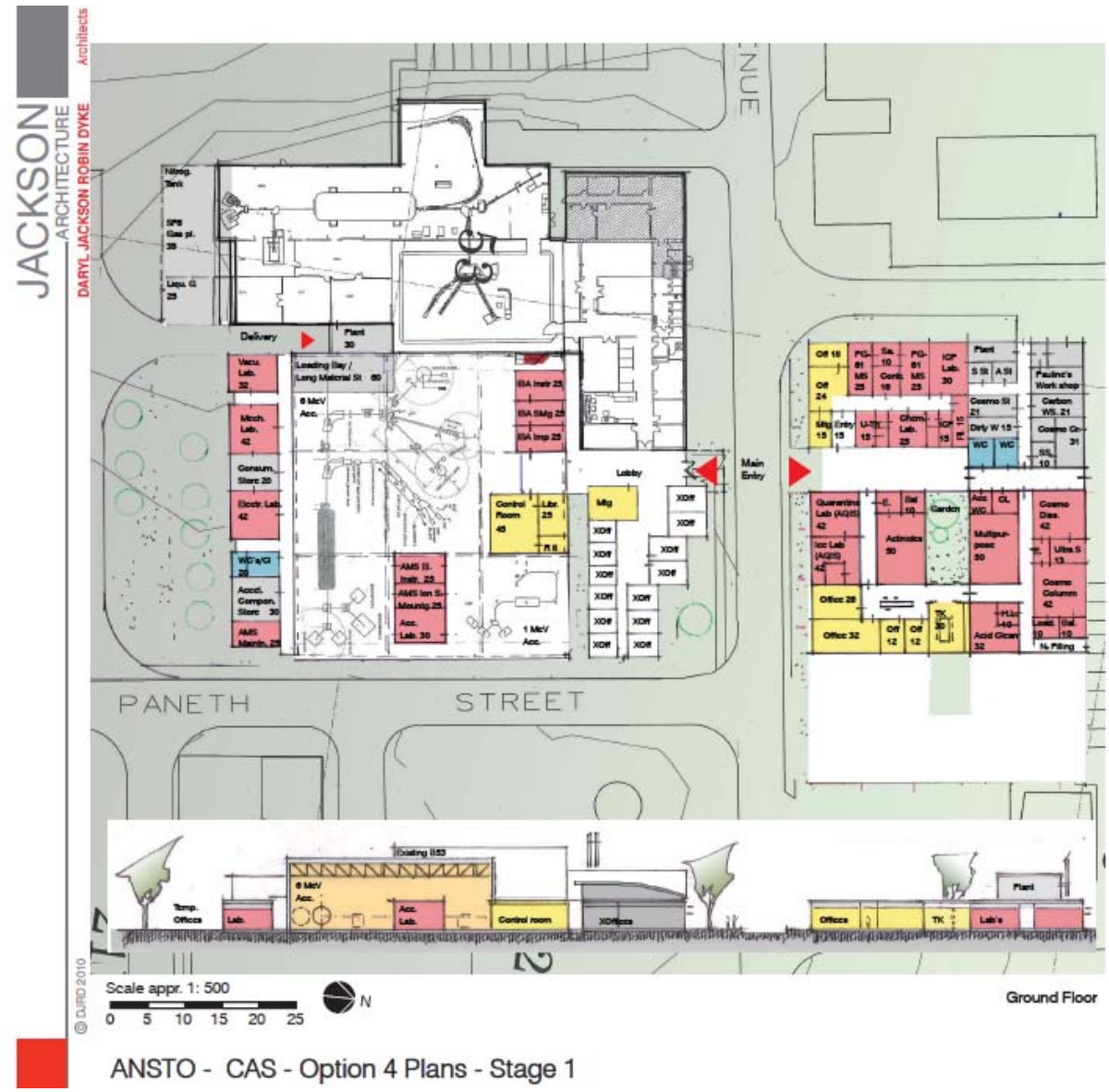



**Figure 2 Proposed building plan in the selected site locations**

## 3. International Benchmarking

3.1 The Centre for Accelerator Science (CAS) will be a national facility providing scientific capabilities unique within Australia. Consequently ANSTO has looked overseas for benchmark information. The CAS will provide accelerator facilities equipped for use principally for Accelerator Mass Spectrometry (AMS) and Ion Beam Analysis (IBA). In many countries AMS and IBA facilities exist as separate laboratories. As a result, there are only a few facilities overseas with comparable scope (AMS and IBA in the same laboratory). Some of the principal ones are discussed below.

3.2 As with ANSTO's accelerator facilities, these laboratories have developed in stages over several decades, sometimes in new buildings and sometimes expanding inside existing buildings. In this situation, it is not possible to obtain realistic cost comparisons. Instead, comparisons have been made of the building areas occupied by comparable facilities, and of capabilities and staffing levels.

3.3 The Institute of Ion Beam Physics and Materials Research, Forschungszentrum Dresden-Rossendorf, Germany, is used principally for IBA and related materials studies, with a new 5 million volt (5 MV) accelerator currently being commissioned with both IBA and AMS capabilities. The overall accelerator facility houses four accelerators and associated laboratories in a building area of around 4000 square metre ($m^2$). ANSTO's new Accelerator Hall, plus the adjoining existing building housing the ANTARES accelerator, will house 3 accelerators and associated labs in an area of 3000 $m^2$. The German laboratory has not yet developed comparable AMS capabilities so a comparison with ANSTO's new AMS Chemistry building is not applicable.

3.4 The University of Vermont, United States of America (USA), has recently built a new 'Cosmogenic Nuclide Laboratory' with similar function to that part of ANSTO's new AMS Chemistry facility which will be used for processing rock samples for cosmogenic nuclide dating. A recent visit to ANSTO by the research group leader at the Vermont laboratory, Professor Bierman, has enabled ANSTO to compare laboratory layouts and functionality. This consultation process has aided in designing ANSTO's proposed laboratories for the most effective use of space.

3.5 The Vermont laboratory does not possess its own accelerator facility but instead takes their samples to the Lawrence Livermore National Laboratory (LLNL) for analysis. The Centre for Accelerator Mass Spectrometry at LLNL operates comparable facilities to ANSTO's accelerators. They have three accelerators, one similar to ANTARES and two smaller 1 MV machines, providing a similar range of AMS capabilities to ANSTO's CAS and a more limited range of IBA capabilities.

3.6 The Laboratory of Ion Beam Physics at the Swiss Federal Institute of Technology, Zurich, is another laboratory with capabilities very similar to LLNL, with one 5 MV accelerator and two smaller accelerators, used predominantly for AMS. The similarity of facilities is also reflected in a similarity in staffing levels, with around 30 staff at the Swiss laboratory, at LLNL and at ANSTO. This demonstrates a consistency in ANSTO's operations and building space requirements with leading overseas laboratories.

3.7 Other comparable overseas facilities include: the Scottish Universities Environmental Research Centre, United Kingdom (UK); the Aster accelerator at the Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement (CEREGE), France; Surrey Ion Beam Centre, University of Surrey, UK; and the Ion Beam Lab, Sandia National Laboratories, USA. The first two are used for AMS only, while the second two are used for IBA and related materials science.

# ATTACHMENT A – Facility Areas

**Floor Areas**

The proposed development will comprise an overall area of approximately 3,300 $m^2$. This is made up of 1,100 $m^2$ for an Accelerator Hall, approx 200 $m^2$ for office space, 1,000 $m^2$ for laboratories, plus allowance for amenities, plant rooms and general circulation.

These floor areas are detailed below, noting that the Accelerator Facilities will be constructed as an extension to Building 53, and therefore extensive use can be made of the existing facilities of that building. As a result the amount of space required for offices, plant, utilities, IT equipment and amenities is reduced.

**Table 1 – Accelerator Facilities**

| Accelerator facilities | Qty | Area sqm | Total sqm | Comments |
|---|---|---|---|---|
| **Accelerator Halls** | | | | |
| 1. 6 MV Accelerator | 1 | 850 | 850 | Tandem Accelerator, beam lines & microprobe |
| 2. Compact AMS 1 MV Accelerator | 1 | 250 | 250 | Compact Accelerator & beam lines |
| | | | | |
| **Storage** | | | | |
| 3. Components store | 1 | 30 | 30 | Accelerator spare parts and equipment |
| 4. Consumables store | 1 | 20 | 20 | Electrical wiring, fittings, hoses, tubing and other common materials |
| | | | | |
| **Offices** | | | | |
| 5. Technical library | 1 | 25 | 25 | Documentation, drawings and maintenance logging |
| 6. Control Room | 1 | 45 | 45 | control computers and instrumentation |
| 7. Staff Offices (shared) | 2 | 12 | 24 | Tech staff, Ppstdoc + visitors |
| 8. Overnight rest area | 1 | 8 | 8 | |
| | | | | |
| **Laboratories / Service Rooms** | | | | |
| 9. Electronics/Electrical lab | 1 | 42 | 42 | Maintenance & development |
| 10. Vacuum repair & maintenance lab | 1 | 32 | 32 | Repair & maintenance |
| 11. Mechanical lab | 1 | 42 | 42 | Maintenance & development |
| 12. Ion source mounting lab & archive | 1 | 25 | 25 | cathode mounting and archiving |
| 13. Ion source cleaning lab | 1 | 25 | 25 | cleaning and storage |
| 14. AMS Electronics instrumentation & detector service | 1 | 25 | 25 | storage, servicing and repair |
| 15. Sample mounting, control & data acquisition - IBA | 1 | 25 | 25 | mounting samples prior to measuring |
| 16. Ion Implantation and sample preparation - IBA | 1 | 25 | 25 | locate equipment associated with the preparation of samples |
| 17. IBA Electronics instrumentation & detector service | 1 | 25 | 25 | storage, servicing and repair |
| 18. Small accelerator lab | 1 | 30 | 30 | sample mounting, accelerator component adjustments and repair |
| | | | | |

| Accelerator facilities | Qty | Area sqm | Total sqm | Comments |
|---|---|---|---|---|
| **Facilities** | | | | |
| 19. Gas Handling Plant | 1 | 35 | 35 | Equipment associated with the transfer of gases to and from 6MV |
| 20. Accelerator General Plant Area | 1 | 35 | 35 | Mobile SF6 gas handling, compressed air, & associated Accelerator equipment |
| | | | | |
| **General Plant** | | | | |
| 21. Cleaners | 1 | 8 | 8 | Cleaners Rooms |
| 22. Amenities | 1 | 30 | 30 | Male, Female, Disabled, |
| | | | | |
| **Total required area** | | | **1656** | |
| Internal circulation | | | 330 | |
| **ACCELERATOR FACILITIES GROSS AREA** | | | **1986** | |

## Table 2 - AMS Chemistry Facilities

| AMS Chemistry Facilities | Qty | Area sqm | Total sqm | Comments |
|---|---|---|---|---|
| **Storage** | | | | |
| 1. Corrosive Store | 1 | 12 | 12 | Compliant storage areas at rear of facility |
| 2. Solvent Store | 1 | 12 | 12 | Compliant storage areas at rear of facility |
| | | | | |
| **Offices** | | | | |
| 3. Team Leaders – Cosmo & Actinides | 2 | 12 | 24 | 2 staff |
| 4. Cosmogenics Isotope Team | 1 | 32 | 32 | 4 staff |
| | | | | |
| **Laboratories / Rooms-Carbon** | | | | |
| 5. Quarantine lab | 1 | 42 | 42 | AQIS approved quarantine premises |
| 6. AQIS / Ice lab | 1 | 42 | 42 | AQIS approved & ice lab |
| 7. Speleothem Workshop | 1 | 33 | 33 | |
| | | | | |
| **Laboratories / Room- Non-Carbon** | | | | |
| 8. Storeroom | 1 | 21 | 21 | Storage of lab supplies, samples and files |
| 9. Multi-purpose shared lab (ISO Class 8) | 1 | 50 | 50 | Dissolution & processing chlorine, hot iodine, new isotope lab, balance room & cathode loading |
| 10. Actinides and iodine lab (ISO Class 7) | 1 | 64 | 64 | Processing of actinide and iodine samples |
| 11. Actinides balance / loading room | 1 | 14 | 14 | Balance and loading |
| 12. Cosmo balance room (ISO Class 7) | 1 | 10 | 10 | Weighing of Be and Al samples |
| 13. Cosmo cathode loading (ISO Class 7) | 1 | 10 | 10 | Cathode loading Be and Al samples |
| 14. Cosmo column lab (ISO Class 8) | 1 | 42 | 42 | Column chemistry and calcining |
| 15. Cosmo dissolution lab + balance room | 1 | 42 | 42 | Cleaning and dissolving samples |
| 16. Cosmo ultra-sonification lab | 1 | 13 | 13 | Ultra-sonication and weighing |
| 17. Heavy liquid / Frantz lab | 1 | 10 | 10 | Density and magnetic separation |
| 18. Acid lab | 1 | 31 | 31 | Sample cleaning using phosphoric acid and Aqua regia |
| 19. Cosmo rock crushing and sieving (needs outside doors) | 1 | 31 | 31 | All in one crush and then sieve rocks |
| 20. Cosmo sample sorting | 1 | 11 | 11 | Storage and selection of samples |
| | | | | |
| **Facilities** | | | | |
| 21. Network Room | 1 | 9 | 9 | IMS |

| AMS Chemistry Facilities | Qty | Area sqm | Total sqm | Comments |
|---|---|---|---|---|
| 22. Entry/Foyer | 1 | 30 | 30 | Entrance Foyer |
| 23. Cleaners | 1 | 8 | 8 | Cleaners Room |
| 24. Amenities | 2 | 20 | 40 | Male, Female, Disabled, toilets & showers |
| 25. Utility room | 1 | 16 | 16 | Mail / Print / Fax / Copier |
| 26. Kitchen | 1 | 20 | 20 | Building Tea Room - Kitchenette |
| | | | | |
| **Total required area** | | | **669** | |
| General plant area | | | 110 | |
| Internal circulation | | | 133 | |
| **AMS CHEMISTRY FACILITIES GROSS AREA** | | | **912** | |

## Table 3 – Uranium Series Laboratories

| Uranium Series Laboratory Areas | Area sqm | Comments |
|---|---|---|
| **General Area** | | |
| 1.Main Workroom | 14 | For lead scientist |
| 2.Office space for 4 hotdesks | 24 | |
| 3.External Sample Cleaning Area | 6 | Area for cleaning coral samples prior to spectrometry |
| 4.Dirty Workshop | 9 | |
| 5.Meeting Room | 15 | For roughly 12 people. May also contain kitchenette (depending on distance from alternate CAS staff room areas). |
| 6.Toilet – Unisex – Disabled Access | 0 | Share |
| 7.Toilet - Unisex | 0 | Share |
| **Lab Area** | | |
| 8.Entry Control & First Stage Change | 15 | |
| 9.Control Room for Mass Spectrometers | 16 | Large enough for 2 people plus controlling equipment for NG- 61 and PG- 61. Windows into the NG- 61 and PG- 61 rooms would also be advantageous. |
| 10.Sample Loading Room | 10 | 1 x fume cupboard |
| 11.PG-61 Mass Spectrometer | 25 | Will house a mass spectrometer (noted as PG-61) |
| 12.NG-61 Mass Spectrometer | 25 | Will house a mass spectrometer (noted as NG-61) |
| 13.General Chemistry Lab | 25 | Metal free lab. Metals are not to be used in lab (inc. fume cupboards) due to work carried out, 2 x laminar flow cabinet |
| 14.Balance Room | 3 | |
| 15.Entry/Change 1 | 4 | Second changeroom for U-Tn room |
| 16.U-Tn Room | 15 | 1 x laminar flow cabinet |
| 17.Entry/Change 2 | 4 | Second changeroom for ICP Mass Spec room |
| 18.ICP Mass Spectrometry Room | 15 | 1 x laminar flow cabinet |
| 19.ICP Laser | 30 | |
| 20.Filament Making and General Maintenance Room | 12 | |
| | | |
| **Total required area** | **267** | |
| General plant area | 74 | |
| Internal circulation | 53 | |
| Uranium Series Laboratories Gross Area | **394** | |

## ATTACHMENT B – Siting Options Considered

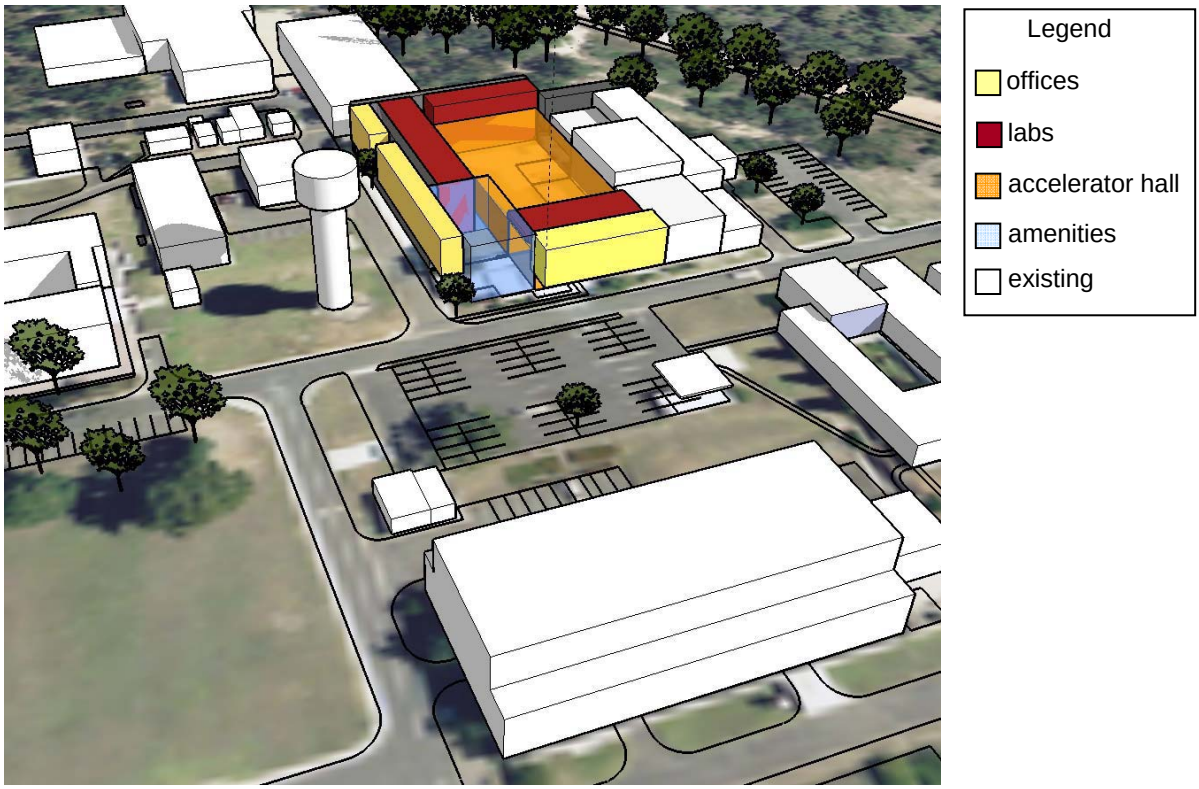
There were three options considered initially which are referred to on page 19 of the original submission (options 1, 2 and 3, below).

**Option 1**

Entire facility located as part of Building 53, the ANTARES Building, requiring some demolition of existing infrastructure.

This option was initially considered one of the two most feasible solutions meeting most of the essential requirements, and enhancing the Centre for Accelerator Science vision. It was one of the options presented to the PWC on 9 April. However, the issues against this option were:

a) the need to demolish existing infrastructure;
b) the chemistry laboratories were to be split over two separate levels therefore limiting the loadbearing functionalities required for the essential activities; and
c) the proposed superstructure of the accelerator hall did not permit multi-storey construction and so would occupy the majority of the site footprint thus limiting possibility for future expansion of either the accelerator hall or the chemical laboratories.




**Concept Drawing - Option 1**

**Option 2**

Facility located in the vacant block north of the IER administration building on a green field site. This option was not considered a feasible solution as it did not meet all of the essential requirements. Significant issues against this option were:

a) the facility was isolated from existing infrastructure and other related buildings;

b) it did not permit economical workflow for operational staff; and

c) did not enhance the Centre for Accelerator Science vision.

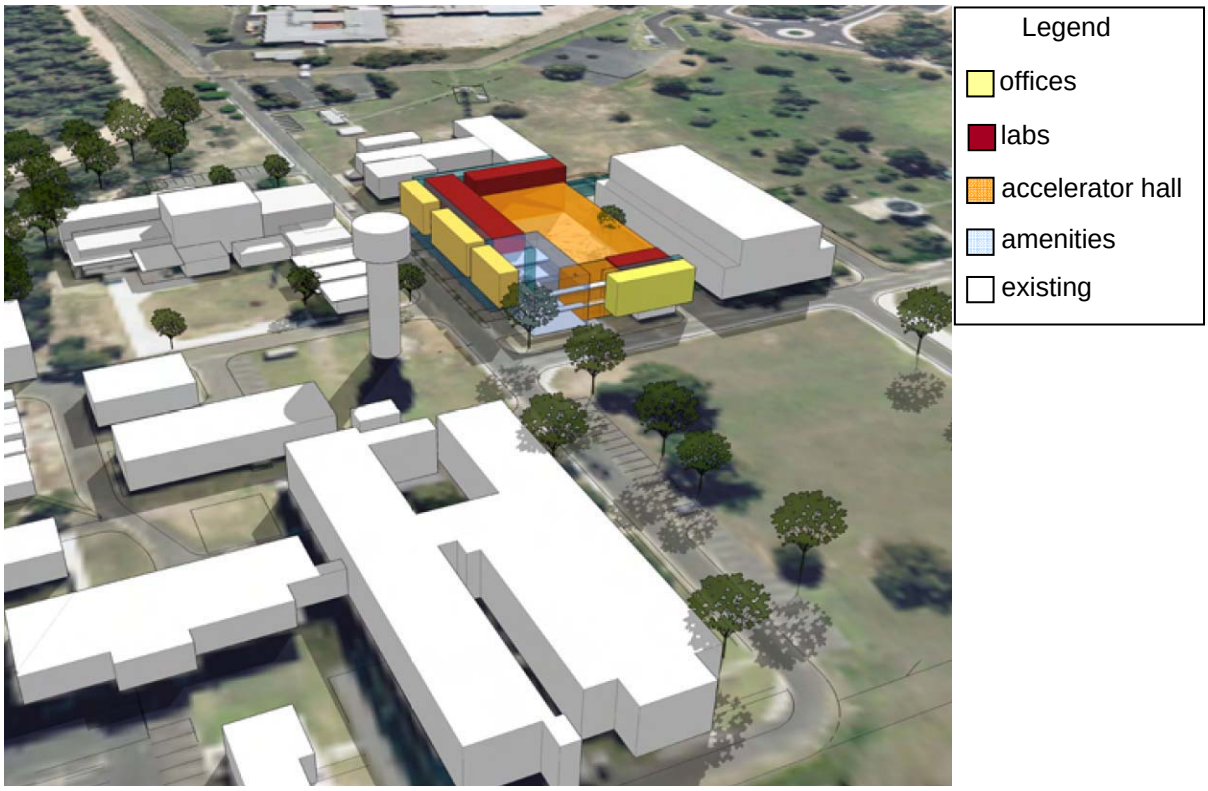

**Concept Drawing - Option 2**

**Option 3**

Entire facility located on the existing car park between Building 53 (ANTARES) and Building 22 (STAR accelerator building).

Since it did not meet all of the essential requirements, this was not considered to be a feasible solution. Factors against this option were:

a) that the facility's accelerator operations were isolated from existing services and infrastructure;
b) it would not permit simultaneous irradiation experiments in the ANTARES target hall; and
c) the lot size did not allow a design that permitted good work flow for the chemistry laboratories because it separated them over numerous levels.




**Concept Drawing - Option 3**