Submission No. 001a
(ANSTO Facilities)
SL
Date: 25/02/2010

Inquiry: proposed construction of Centre for Accelerator Science and extension to facilities for the Australian Nuclear Science and Technology Organisation

Submission 1a: Proposal for a new Centre for Accelerator Science

Part 1 of 3. Parts 2 and 3 are:

- Submission 1b: The Bragg Institute Offices and Laboratory Proposed Extension
- Submission 1c: Opal Offices, Workshops and Laboratories Extension

ENGINEERING & TECHNICAL SERVICES

MAJOR PROJECTS DELIVERY OFFICE

Submission to the Parliamentary Standing Committee on Public Works

Proposal for a new Centre for Accelerator Science (CAS)

MPDO-CAS-0005-PWC

FEBRUARY 2010

REVISION SHEET

		Print name, date and sign or initial			
Revision Number	Description of Revision	Prepared	Checked/ Reviewed	Approved	Agreed
0	Initial Issue	Shane Harrison	Michael Hotchkis	Steve McIntosh	Adi Paterson
Notes: 1. Revision shall be verified in accordance with the Quality Plan for the project.					
2. Revision to be agreed by the relevant Customer					

TABLE OF CONTENTS

Executive Summary

The Australian Nuclear Science and Technology Organisation (ANSTO) is seeking approval from the Public Works Committee to construct a building to house the new Centre for Accelerator Science at ANSTO's site at Lucas Heights in Sydney. The proposed centre will house two new world class accelerators, laboratories, workshops, and offices.

ANSTO is Australia's national nuclear research and development organisation, and the centre of Australian nuclear expertise. ANSTO is responsible for delivering specialised nuclear-related advice, scientific services and products to government, industry, academia and other research organisations.

In particular, a central part of ANSTO's mission is the operation of major nuclear facilities, including particle accelerators. ANSTO's Institute for Environmental Research (IER) currently operates two accelerators, delivering excellence in accelerator-based science through leading-edge ion beam research and provision of high sensitivity analytical technologies for the benefit of internal and external users. Existing facilities are used annually by over 100 external researchers and other clients. These users include researchers from a variety of scientific disciplines at Australia's universities and other research organisations, and a number of international scientific collaborators. In addition, analytical services are provided to a range of government agencies and private companies. These facilities support work in key areas of environmental science, including research into climate change, water resources and air pollution. Other areas of application include sample analysis in support of nuclear non-proliferation, research for radiation medicine, and studies of materials engineered for applications in medicine and nanotechnology.

The existing facilities are in urgent need of renewal and improvement to ensure that ANSTO can continue to be at the forefront of applied accelerator science. New purpose-built laboratories, suited to handling samples for ultra-sensitive analytical methods, are required to replace aging infrastructure dating from the 1960s. These custom-built labs will be co-located with new accelerator facilities to ensure they are truly world-leading facilities. The new accelerators and will add additional capability to ANSTO's existing accelerator capabilities. The older of ANSTO's existing accelerators, ANTARES originally built in the 1960s, will be re-used as a facility for materials research by ANSTO's Institute for Materials Engineering.

The potential to increase the use of accelerators in a range of scientific pursuits was recently identified by the Australian Federal Government in the 2009/10 budget when it allocated $25 million under the Education Investment Fund (EIF) to establish the new Centre for Accelerator Science at ANSTO. ANSTO will also be making a substantial contribution from its own funds to this major initiative.

1. IDENTIFICATION OF THE NEED

1.1 Principal objectives

It is proposed that ANSTO construct a new building to house its new Centre for Accelerator Science (CAS) at ANSTO's site at Lucas Heights in Sydney. The objective of the proposed centre is to ensure that world-leading accelerator-based research facilities are available in Australia for the benefit of Australian science and education.

The key objectives of the CAS Project include the following:

1. To ensure that ANSTO can continue to provide the Australian research community with first class facilities for accelerator mass spectrometry and ion beam analysis.

2. To ensure that ANSTO has the facilities to support key research areas and services of national importance, for use in areas such as materials characterisation, ion beam interactions with matter, climate change research, water resource studies and national security.

1.2 Historical background

Accelerator science has been a key part of ANSTO's research facilities since the 1960s. Over the course of the past 40 to 50 years, these accelerator facilities have transformed themselves from machines for nuclear physicists to facilities housing tools vital to a wide range of sciences. While media attention has focussed on the development of huge facilities like the Large Hadron Collider in Switzerland, here in Australia (and elsewhere around the world), relatively small accelerator facilities have been making their mark by supporting the latest scientific progress in areas from climate change science to nanotechnology.

With its existing accelerators, ANSTO provides facilities to over 100 users every year, coming from across Australia, and attracting collaborators from around the world. There is a growing user base and growing demand. It is necessary now to re-invest in our facilities to meet future needs.

1.3 Scientific background

Accelerator-based research is vital to the study of climate and environmental science; nuclear safeguards and forensics; materials science; medical physics; and radiation physics. Australian researchers use ANSTO's current accelerator facilities principally as very high sensitivity analytical facilities to support research in these areas. Accelerators measure, very accurately, minute amounts of a particular substance in a much larger volume. The two main techniques carried out are:

1. Ion Beam Analysis (IBA) – where an accelerated ion beam impinges on a sample, enabling study of the properties of the sample surface, such as its elemental composition. This analysis can be performed at the sub-micron scale, if required, depending on the nature of the study.

2. Accelerator Mass Spectrometry (AMS) – where the whole accelerator system is used as an ultra-sensitive mass spectrometer, to study the isotopic composition of a sample. This makes it possible to measure the amounts of extremely rare long-lived radioisotopes, such as ^{14}C for use in radiocarbon dating, and a variety of other isotopes not measurable by other means.

Accelerated ion beams may also be used to deliver carefully controlled doses of radiation to study the effects of that radiation. This is important for the development of new medical radiation treatments and researching ways of assessing the dose given in such treatments.

Some recent examples of applications of ANSTO's accelerators:

1. An international collaboration involving ANSTO measured radiocarbon in methane trapped in ancient ice to discover the source of releases of this important greenhouse gas near the end of the last ice age. ANSTO contributed its expertise in measuring radiocarbon in extremely small samples. The results were recently published in the prestigious journal, *Science*.

2. ANSTO has several major national and international collaborations applying accelerator based nuclear techniques to the characterisation and source identification of fine particulate ambient air pollution. These include a long term 10 year IAEA/ RCA project studying sources and long range transport of air pollution within 15 countries across Asia; a national project with ANU and Monash with ARC funding to study major desert dust events from central Australia and their movements across the eastern seaboard and their impacts on the Great Barrier Reef.

3. Atmospheric radiocarbon variations are of immense scientific interest because they reveal crucial information about the linkages between climate, ocean circulation and the carbon cycle. ANSTO, with collaborators, is studying the past record of atmospheric radiocarbon as archived in tree rings, and has discovered anomalies in SE Asia which do not fit with the expected differences between N and S Hemispheres (published in *Quaternary Geochronology*).

4. Soil erosion: using high sensitivity measurement of long-lived radioisotopes, soil erosion rates have been determined in Arnhem Land, NT. Quantifying these processes helps our understanding of spatial variation in soil thickness and aids in the prediction of the sustainability of soil resources.

5. Samples collected from around the world by International Atomic Energy Agency (IAEA) inspectors are used for monitoring of the Non-proliferation Treaty. ANSTO is part of a network which analyses these samples for minute traces of signatures of nuclear activities. ANSTO uses its AMS capabilities for this purpose.

6. Heavy metal accumulation by plants: the heavy ion microprobe on the ANTARES accelerator is being applied to better understand the phenomenon of hyperaccumulation of heavy metals in plants. Some Australian plant species are capable of accumulating up to 4% dry weight of Co, Ni and Mn. Our work identifies the location of the accumulations at the cellular level in root, stem and leaf sections.

7. In a study of the effects of physical and chemical properties on the biological response to coated materials, ion beam techniques have been used to characterise the surfaces (published in Biomaterials). In this work, the hydrogen depth profile in thin DLC (diamond-like carbon) films has been measured by nuclear reaction analysis. Surfaces of amorphous Si solar cells and ZnO semiconductor have been also been studied in this way.

8. Radiocarbon dating of the groundwaters within the Gnagarra Mound aquifers, which supplies ~60% of Perth's water supply, has provided essential information to a study of the groundwater flow paths and recharge rates of the aquifer system. This study improves the understanding of aquifer distribution, groundwater flow patterns and the hydraulic connection between the aquifers enabling better management of water resources in this area.

1.4 Education Investment Fund (EIF) Project

The potential to increase the use of accelerators in a range of scientific pursuits was recently identified by the Australian Federal Government in the 2009/10 budget when it allocated $A25 million to establish the Centre for Accelerator Science at ANSTO. ANSTO will fund separately the remaining component of the forecast budget.

A funding agreement for the Centre for Accelerator Science has been entered into between the Commonwealth of Australia (as represented by the Department of Innovation, Industry, Science and Research) and ANSTO.

The funding arrangement provides that the two new accelerators and facilities are to be commissioned at ANSTO over four years, with a completion date set for 31 March 2014.

A Project Plan for the facilities has been submitted to the Department and the specific milestone dates detailed drive the funding instalments, with quarterly milestone and annual reports to be provided. An extract of the milestone dates from this plan is **Appendix A.**

1.5 Existing Facilities

ANSTO's current facilities include the 10 Mega Volt (MV) ANTARES accelerator and the 2 MV STAR accelerator, which are able to provide both ion beam analysis (IBA) and accelerator mass spectrometry (AMS) capabilities. Associated with the accelerators are extensive laboratories for sample preparation and for development of instrumentation.

- STAR Accelerator and Building:

The STAR Accelerator building (Building 22) was built in the early 1960s to house a former accelerator and a now-decommissioned reactor. The building, which is shared with other sections of ANSTO, houses development laboratories, sample preparation and analysis areas associated with ion beam analysis, and office space mainly for accelerator technical staff. Parts of the building have been refurbished in recent years for these purposes.

The building also houses the 2 MV STAR accelerator, which was acquired with joint funding from the Australian Institute for Nuclear Science and Engineering (AINSE), ANSTO and a consortium of Australian Universities and has been operating for six years. This Tandetron-type accelerator can produce a wide range of light and medium weight ions, with energies from a few hundreds of keV to 4 MeV for ion beam analysis. The STAR accelerator also has an AMS 14C beam line used for routine radiocarbon measurements. The main applications of STAR includes radiocarbon dating, surface and bulk analysis of solid state materials, environmental pollution monitoring, archaeological artefact elemental determinations, studies of pigment composition in paintings, biological studies using tracer elements and studies of geological material. The STAR accelerator will continue to be used for the above applications, with the proposed centre building upon the capabilities already provided by STAR.

- ANTARES Accelerator and Building:

The ANTARES Accelerator Building (Building 53) commenced construction in 1970. It was extended the west to cater for ANTARES in the late 1980's, and also extended to the east in the 1990's to accommodate office space. The overall building now houses office space for scientific and technical staff, halls for accelerator science, and rooms for accelerator maintenance, stores and instrument development and repair.

ANSTO's 10MV tandem accelerator ANTARES (Australian National Tandem Research Accelerator) is a 45-year-old accelerator which was re-fitted following its transfer to ANSTO in 1989, commissioned in 1991 and substantially upgraded during the 1990s. The acquisition of ANTARES in 1989 followed the recommendation of the Australian Academy of Sciences that Australia had a key need in this area. It provides capabilities for analysis of a wide range of long-lived radioisotopes by AMS and beams for IBA and radiation research applications, including with a heavy-ion microprobe. In particular the accelerator provides ion beams with energies from 5 to 100 MeV, depending on the ion species, with beam intensities up to a few microamperes. Virtually any naturally occurring isotope can be produced as a beam, free from contamination of other isotope species or molecular ions. Given the age of the ANTARES accelerator, it has high maintenance costs, exacerbated by multiple modes of use, and is at risk of major component failure in coming years. The ANTARES Accelerator will in future be utilised by ANSTO's Institute of Materials Engineering for research in to radiation effects on material. This kind of usage, with prolonged periods of continuous beam on a single beamline, is expected to require reduced maintenance and operational costs.

- Laboratories: AMS sample preparation (Building 16):

ANSTO has one of the few AMS laboratories world-wide that is able to provide sample processing for all the isotopes measured on its accelerators. The current facility in B16 and B16A comprises an extensive suite of laboratories, offices and storage space for the processing of samples for AMS analysis, as well as amenities, stores and a workshop that are shared with other sections within ANSTO. The current facilities are at capacity in providing targets for the ANTARES and STAR accelerators for AMS measurement. The laboratories were established in the early 1990's, fitting into areas as space became available, and as such are spread across B16 and B16A; they are of an age where they no longer comply with ANSTO laboratory standards, and maintenance of plant and services is increasing. With no space to grow, the ability to develop new or expand existing capabilities is hindering our ability to function effectively.

- Uranium Series Laboratories

The Uranium Series Laboratories are a replacement of existing laboratories at the Australian National University, where one of the Mass Spectrometers (NG-61) is currently housed. This device is scheduled to be relocated to the proposed centre once the new facility becomes available, along with and additional machine that requires assembly.

1.6 Description of the Proposal

The overall project aim is to establish a new Centre for Accelerator Science at ANSTO, which will include new facilities in a new building in close proximity to the existing accelerators. The new building will include the following major components:

1. accelerator halls;
2. associated instrument development and maintenance laboratories;
3. new sample preparation laboratories integrated with the accelerator facilities, to expand capacity and replace the aging infrastructure currently in Building 16;
4. new office space with provisions for external users; and
5. visitor display area to permit school and other tour groups to view the facilities.

Details of the space required and proposed layout are described in the Technical Information below.

Included in the EIF agreement is the provision for:

1. a new Compact multi-isotope accelerator mass spectrometry (AMS) accelerator operating at up to 1MV (approx $4.5million in value);
2. a new medium-energy tandem accelerator, operating at up to 6MV capable of delivering beams for both AMS and IBA applications (approx 6.5M in value); and
3. a confocal heavy ion microprobe and associated IBA beam lines (approx $2M in value).

The delivery of this equipment is being managed by the project team under the program of work, however, this equipment supply does not constitute a public work as confirmed by the PWC secretary.

A further subproject of CAS, being delivered by the project team, is the Gas filled Magnet (GFM) Project (approx $1M in value). The work scope and budget are being managed separately as this component is being developed for current facilities on the ANTARES accelerator, and as such does not constitute a public work.

A separate project at ANSTO, the Uranium Series Laboratories, will also be included as a sub project of the CAS facility. This building has similar requirements and research outputs, and so cost savings are available by joining the projects. The Uranium Series Labs is forecast at $3 million, bringing total expenditure to $38 million. This scope is included in this submission.

1.7 The Need for the Work

The construction of a new facility to house the two new world class accelerators, laboratories, workshops, and offices, is essential to the creation of the new Centre for Accelerator Science.

The requirement for the new building work arises for the following reasons.

Scientific drivers

In Section 1.3 above, the scientific applications of our current facilities were outlined. The areas of application include the study of climate, environmental science and water resources; nuclear safeguards and forensics; materials science; medical physics; and radiation physics. All these areas are key areas prominent within the National Research Priorities. The new Centre will provide for the long term future of studies in these areas. The planned facilities and beamlines and their scientific applications are outlined below.

The Compact AMS accelerator will be used for three functions:

1) High efficiency, high precision and high throughput analysis of radiocarbon samples, using the world's best practice methods to achieve optimum performance. Radiocarbon analysis is essential to many areas of research as outlined above. 50% of available time is expected to be used for this application.

2) Analysis of actinides with optimised performance. AMS has been demonstrated to be the most sensitive method available for detection of actinides such as uranium and plutonium and such analyses are critical to safeguards, security and environmental applications. This accelerator will be the world's first compact AMS custom-designed for this application and aims to achieve a factor of ten further improvement in sensitivity.

3) Experimental investigation of AMS techniques at voltages below 1.0MV for analysis of a variety of other long-lived radioisotopes. This experimental work is of a more speculative nature and is subject to further development by ANSTO in the future. Some initial work has been done in this area in overseas labs and indicates great potential for further development.

Tandem accelerator at up to 6MV terminal voltage:

This will be fitted out with the following facilities and capabilities:

Accelerator Mass Spectrometry (AMS) system

The Tandem accelerator will provide world-class performance in AMS isotopic ratio measurements for 10Be, 14C, 26Al, 36Cl, 41Ca and 129I. The system will be characterised by high efficiency and precision and operate under fully automated computer control. For maximum efficiency and effectiveness, two high output sputter ion sources are required and multiple-option ion detection systems. The latter will enable switching between (i) general use gas ionisation chamber with absorber cell for 10Be, (ii) time-of-flight detector leg for 129I, and (iii) a gas-filled magnet detector for 26Al, 36Cl and others subject to further development.

The above radioisotopes are applied to problems in climate change, glaciology, geomorphology, soil science, hydrology, nuclear monitoring and other areas.

Ion beam analysis (IBA) systems

The proposed new facility will use ion beam techniques to characterise a variety of thin films and interfaces, such as the hydrogen depth profile in thin DLC (diamond-like carbon) films, amorphous Si solar cells, ZnO semiconductor or polymer thin films used for biologic implants. In addition, specific light isotope measurements will be performed, such as the ratio 10B/11B in MgB2 thin films which play an important role in the properties of this superconductor.

It is proposed to use high and low energy ion beams to create non-equilibrium thin films. This represents a new approach with applications in biology, micro-electronics and other areas, which will take advantage of our combined expertise in ion beam interaction with matter and in the use of IBA techniques to characterise surfaces, near-surface regions and interfaces for element depth profiling with mono-layer resolution in order to tailor macroscopic physical properties of material surfaces. High and low energy ion beams will be used to induce specific radiation damage in materials, to develop a fundamental understanding of radiation damage processes. Ion and neutron beams will be available for irradiation of biologic material for further advancement of microdosimetry and radiation protection.

For these purposes, and to further the kinds of studies outlined in the Scientific Background section above, IBA will require a variety of beams with high intensities suited microprobe and other applications. For this purpose, three types of ion source are needed:

• duoplasmatron or similar to provide proton beams

• charge exchange source for helium beams

• high intensity sputter source for a wide range of heavy ions (to be shared with AMS)

The following beamlines are required for the kind of work outlined above.

Confocal microprobe: on this beamline, the beam will be focussed to less than 1 micron spot-size on the sample. With scanning capability, 2D images of elemental composition at this resolution can be built up. In addition, and making this system world-leading, a multi-capillary X-ray detector will be used, enabling depth profiles to be measured, leading to true 3D composition mapping.

Elastic Recoil Detection Analysis with Time-of-flight detector (ERDA-ToF) Beamline: analysis of thin films with very high depth resolution

Nuclear Reaction Analysis (NRA) and High Resolution Rutherford Backscattering (RBS) Beamline: analysis of thin films, including hydrogen content

On-line ion Implanter beamline: ion beam modification of materials with high and low energy ion beams and subsequent analysis.

Future for ANTARES

The transfer of the current activities from the old ANTARES accelerator to the new facilities will free up available beam time on the ANTARES accelerator. The newly available beam time on ANTARES will be used for research into the effects of radiation on materials. The key objective here will be to underpin the development of the future generation of fission and fusion nuclear reactors, through improved understanding of the behaviour of materials under extreme conditions of radiation impact. To enable this work, long irradiation times (many months at a time) in a shielded environment are required. ANTARES, freed from current commitments, will be able to provide this. Several high-profile nuclear laboratories overseas are currently planning or implementing similar capabilities. ANSTO needs to be able to play a role in this area, in order to be in a position to provide advice on the future development of nuclear power.

Expanded capacity

There is presently a high level of unmet user demand for both existing accelerators, as evidenced, for example, from the level of demand for beamtime requested in AINSE grant applications compared to that available. On average, 40% of applications for radiocarbon dating are not awarded, resulting in an unmet demand for this application. There is also an increasing demand from ANSTO researchers for radiocarbon analysis. Trends internationally show a growing demand for Accelerator Mass Spectrometry, with at least 5 new facilities being commissioned each year around the world.

The new AMS Chemistry laboratories will have an expanded sample processing capacity to increase sample throughput in order to meet the expected increase in demand for AMS analysis. An increased sample throughput and increased AMS accelerator time will allow us to become competitive on an international scale.

By providing increased capacity, ANSTO's new Centre for Accelerator Science will expand opportunities for the organisation and its partners.

Replacement of aging infrastructure

The need for modernisation is also driving the case for rejuvenation of ANSTO's accelerator facilities and associated laboratories.

The new Centre will include laboratory facilities for preparation of samples prior to applying high sensitivity accelerator-based analysis techniques (item (5) in Section 1.6 above). Ultra-clean laboratory conditions are required to ensure the integrity of the analysis results. Currently, the sample processing laboratories are housed in the 50-year-old Building 16 and 16a, at a separate location on the ANSTO site, along with offices for the staff who work in those labs. These laboratories were not purpose-built, no longer meet ANSTO standards and suffer from consequent problems such as dust and insect incursions and air-conditioning failures causing flooding. With no room for expansion, the AMS chemistry capability is restricted in its ability to increase sample throughput, or implement new capabilities.

Greater efficiency

The new accelerators will be modern facilities built to the latest standards. This will have several benefits in terms of lowered costs and greater efficiency. The new accelerators will be fully automated, permitting unattended out-of-hours operation for maximum throughput and reduced manpower requirements. Compared to ANTARES, maintenance costs are expected to be greatly reduced.

By building the new facilities, including the sample preparation laboratories in the vicinity of the existing STAR & ANTARES accelerators it will create a campus-style centre for accelerator science, with all associated facilities consolidated to ensure optimum operational efficiency. The proposed centre will also be situated adjacent to the main buildings of the Institute for Environmental Research. The proposed centre will greatly improve the existing situation, where the Building 16 laboratories are a significant distance from the accelerator buildings. With the new building, accelerator operations will be fully integrated.

1.8 Options considered

Options that have been considered in regards to the facility are detailed below. The advantages and/or disadvantages of each option have been included, followed by a summary statement on suitability.

1. Excluding the requirements for the small 1MV accelerator from the facility scope and housing this within the existing Building 22 next to STAR accelerator when the retired MOATA reactor is decommissioned.

- MOATA decommissioning schedule does not align with CAS programme
- The area left by MOATA will require additional work and time to rectify.
- B22 was constructed in the 1960's and is not an ideal location for locating an accelerator for future work.
- Considerable work would be required for services and structure modifications that are near the cost of that for the new facility, considering it would be based around the larger accelerator.

This was not considered the most feasible solution

2. Excluding the AMS chemistry facilities from the facility scope and leaving at it at Building 16

- The space in B16 is required by other ANSTO users
- B16 is too small and will not cater for the increased work as a result of 2 additional accelerators
- B16 is an old facility with the quality of laboratories within it of a poor standard and a constraint to the work being conducted
- B16 is isolated from the accelerator facilities at a significant distance (greater than 0.5km) from them.

This was not considered the most feasible solution

3. Constructing the Uranium Series Laboratories as a separate facility

- This would allow for a faster delivery to the client
- The costs for a separate facility would increase as services, utilities, amenities, foyers, overheads and preliminaries all separate
- Forecast costs for this option exceeded the budget available
- This would not ensure optimal operational efficiency

This was not considered the most feasible solution

4. Excluding some accelerator support services from the scope and using existing ones

- Existing facilities are disjointed, isolated, unsuitable and housed in a building constructed 40 years ago.
- Existing facilities do not allow for the increased load of two additional accelerators being installed.

This was not considered the most feasible solution

5. Constructing a Centre for Accelerator Science including space for both accelerators and their servicing, plus the AMS chemistry facilities and the uranium series laboratories as one complete facility

- Management, design and construction costs would be lower if all facilities were combined
- All components would be centrally located
- Meets future demands
- Purpose built facility not one modified to meet needs
- Sample preparation is ideally located next to where the samples are required
- Consolidating these components will promote better relationships with internal areas and not thought of external service providers
- Will attract external user community as a world class facility and allows ANSTO to plan for the future

This was considered the most feasible solution

1.9 Reason for Adopting the Proposed Course of Action

With the existing facilities in urgent need of renewal and improvement, this proposed course of action ensures that ANSTO can continue to be at the forefront of applied accelerator science, meet ANSTO's objectives and deliver on what has been agreed with the Department of Innovation, Industry, Science and Research.

It ensures that ANSTO can continue to provide the Australian research community with first class facilities for accelerator mass spectrometry and ion beam analysis, whilst also ensuring that ANSTO has the facilities to support key research areas and services of national importance, for use in areas such as materials characterisation, ion beam interactions with matter, climate change research, water resource studies and national security.

1.10 Consultation carried out among relevant stakeholders

ANSTO's Engineering and Technical Services Major Projects Delivery Office will be responsible for the overall management of the project, from the development of the concept design through to final completion and commissioning, including the procurement of the accelerator equipment and their installations. During these phases of works, as part of the project management plan, numerous stakeholders will be consulted. Within ANSTO, the proposal will be developed in extensive consultation across the organisation including the Ion Beam Analysis and Accelerator Mass Spectrometry groups of ANSTO's Institute for Environmental Research, the Strategic Assets Program Office, Safety Assessment Committee, Information Management Service, and Campus Services which includes Waste Operations, Security & Safeguards, & Facilities Management.

An External Advisory Group (EAG) has been convened to provide ANSTO with advice regarding the facilities proposed to be provided by this project. The group's members advise ANSTO on the strategic value of the facilities as part of Australia's research infrastructure, as well as contributing their expertise to verify the soundness of the scientific specifications of the facilities. To ensure that the new facilities complement existing facilities in Australia, the External Advisory Group includes leading academic scientists from existing accelerator laboratories at the Australian National University and the University of Melbourne. Two AINSE Councillors serve on the group. AINSE, with its membership of some 39 universities in Australia and New Zealand, represents a very large portion of the extensive user base for ANSTO's current accelerator facilities. The members of the External Advisory Group are:

1. Professor LK Fifield, Dept of Nuclear Physics, ANU: expert on Accelerator Mass Spectrometry and its applications (AINSE Councillor for ANU).

2. Professor R Elliman, Dept of Electronic Materials Engineering, ANU: materials physicist specialising in semiconductor nanotechnology, photonics, and the use of accelerated beams to modify and study the properties of engineered materials.
3. Dr JC McCallum, School of Physics, University of Melbourne: Director of the Microanalytical Research Centre and program manager in the ARC Centre of Excellence for Quantum Computer Technology.
4. Dr R Hashemi-Nezhad, Institute for Nuclear Science, School of Physics, University of Sydney: nuclear physicist and researcher into Accelerator-Driven Systems; user of overseas accelerator facilities.
5. Professor A Chivas, School of Earth and Environmental Sciences, University of Wollongong: expert in isotope geochemistry, user of accelerator-based analysis (AINSE Councillor for UoW and member of AINSE executive).

A copy of the report provided by the External Advisory Group in August 2009, endorsing ANSTO's proposed course of action, is **Appendix B.**

Regarding other external stakeholders ANSTO will consult in detail with the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) with regard to safety matters and licensing requirements, and to a lesser extent the Australian Safeguards and Non-proliferation Office (ASNO), to ensure that the proposed design is in accordance with government security requirements.

Information regarding the governance and communication lines, the project governance structure is **Appendix C.**

1.11 Amount of revenue, if any, to be derived from the project

The facilities being built and commissioned as a part of this project are expected to earn revenue after completion in the form of research grant income and income from commercial services. Currently, ANSTO's accelerator facilities earn around $800,000 per year in external revenue. This is expected to increase in the future due to the expanded capacity and capabilities of the new facilities. For researchers requiring access to our facilities, access is provided through peer review by AINSE Specialist Committees and through collaborative projects. AINSE provides grants to member universities whose projects are selected, and these grants contribute towards the operating expenses of the facilities. For commercial services, full commercial rates are charged to users.

1.12 Environmental and Heritage Considerations

ANSTO is subject to the *Environment Protection and Biodiversity Conservation Act* 1999. Under section 26 of that Act, Ministerial approval would be required if the construction of the CAS project were likely to have a significant impact upon Commonwealth land. Our preliminary assessment is that it is unlikely that the construction of the CAS project will have such an impact; however, a more detailed assessment will be undertaken during the detailed design phase of the project.

ANSTO acknowledges that sound environmental management is integral to this development, and has integrated the Commonwealth Strategy for Ecologically Sustainable Development (ESD) into its land and building assets.

Utilisation of support tools provided by the Australian Government such as the "Considerations for incorporating energy efficiency into requirements for Australian Government owned and leased buildings" (DEH 2006), and compliance with the reporting requirements of the Energy Efficiency in Government Operations (EEGO) Policy will result in the CAS project targeting, as a minimum, an

Australian Green Building Rating (ABGR) of 4.5. These initiatives will add to the project cost, however, it is anticipated that the saving on energy and water consumption will result in a payback of these costs within 10 - 15 years of building occupancy.

The design guidelines for the CAS project will encourage environmental initiatives to be included in the building design, in addition to providing detailed advice on landscaping, planting, fencing, pavements, car park areas, lighting, signage and effective and controlled site preparation, management and maintenance.

All design solutions for the CAS project will be undertaken with careful consideration of the nature of the existing and surrounding assets. Finishes will consider the surrounding environment and buildings in keeping with the existing assets, many of which were built by ANSTO a number of years ago.

In general, construction of the facility will result in short-term, localised, small–scale impact to soils, air quality, flora and fauna, noise, visual amenity and landscape. Management protocols will restrict any impact on surface runoff and erosion and mitigate any other environmental effects.

To enhance the scenic beauty of the ANSTO site and minimise the impact of this development on the site, measures will be instituted to ensure that streetscape works are appropriate, exposed rock or earth faces are revegetated, trees are retained and vegetation is consistent with the native surrounds.

Construction of the new CAS facility may result in some small localised impacts on soil and air quality. However, appropriate measures will be instigated to mitigate any impact on the environment. Likewise, the construction of the CAS project may result in some existing trees being removed. ANSTO will ensure that new trees are planted to compensate for those lost.

There will be no impacts on Aboriginal or non-Aboriginal cultural heritage as a result of the construction of the proposed facility.

It is concluded that the proposed works are unlikely to produce a significant environmental impact. Nevertheless, an assessment of the project under the *Environment Protection and Biodiversity Conservation Act* 1999 will be undertaken.

2. TECHNICAL INFORMATION

2.1 Project Location

ANSTO is situated in Lucas Heights within the local government area of Sutherland Shire Council, approximately 30 kilometres south-west of Sydney's central business district within a 1.6km radius buffer zone. The location for the CAS project is within the 70 hectare ANSTO site.

Figure 1: The blue circle above highlights the ANSTO site.

Figure 2: Aerial view of the ANSTO site taken from the North East

2.2 Project Scope

The scope of this CAS program includes new accelerators and associated facilities. This includes:

Compact Accelerator - a low energy multi-isotope Accelerator Mass Spectrometry (AMS) accelerator with two ion sources, one with gas sample handling capability, and an ion source test bench facility. This accelerator would be primarily used for radiocarbon dating and heavy isotope analysis, including nuclear safeguards work, and experimental work on low energy technique development.

Tandem Accelerator - a modern low-maintenance 5 or 6MV accelerator with the primary use of measuring isotopes of interest for the study of climate change and materials analysis and irradiation. It would have the following capabilities:

- AMS isotopic analysis capability for 10Be, 26Al and 36Cl, extendable to other isotopes as required.
- Confocal microprobe: on this beamline, the beam will be focussed to less than 1 micron spot-size on the sample. With scanning capability, 2D images of elemental composition at this resolution can be built up. In addition, and making this system world-leading, a multi-capillary X-ray detector will be used, enabling depth profiles to be measured, leading to true 3D composition mapping.
- Elastic Recoil Detection Analysis with Time-of-flight detector (ERDA-ToF) Beamline: analysis of thin films with very high depth resolution
- Nuclear Reaction Analysis (NRA) and High Resolution Rutherford Backscattering (RBS) Beamline: analysis of thin films, including hydrogen content
- On-line ion Implanter beamline: ion beam modification of materials with high and low energy ion beams and subsequent analysis.

AMS chemistry Facilities - The new accelerators will be supported by new support facilities and sample preparation laboratories. This will include sample processing and analytical laboratories, chemical and sample storage, and a workshop for:

- Radiocarbon analysis including labs for pre-treatment, carbon isolation, purification and graphitisation
- Cosmogenic isotope analysis such as 10Be and 26Al, 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.
- Stable isotope and elemental analysis required to be performed with the above capabilities.
- Designated Quarantine premises for the initial treatment of samples from overseas

Accelerator Building & Services - In addition to the above scientific facilities, this will provide the building required to house these facilities, including accelerator halls, plant rooms, technical work areas, user laboratories, office space, and common work areas for some of the staff involved in their operations.

Gas Filled Magnet (GFM) – Construction of a dedicated and independent GFM beam line on the existing ANTARES accelerator. This is a sub-project of the CAS program and does not constitute a public work. The subproject is also worth less that $2M.

Uranium Series Laboratories (USL) – State of the art clean room facilities for ultra sensitive isotopic analysis by mass spectrometry. The project will provide a suitable rooms for two Thermal Isotope Mass Spectrometers TIMS), as well as an Inductively Coupled Plasma Mass Spectrometer (ICP MS) and associated laser ablation system (ICP laser).

Of this scope, only the AMS chemistry facilities, accelerator building & services, and uranium series laboratories are subject to public works committee approval.

2.3 Details of Site Selection

The siting selected for the CAS facility is central to the existing accelerators (the STAR accelerator building, and ANTARES accelerator building) and the Institute for Environmental Research administration building. There are currently three options being considered (south and part of B53, between B22 and B53 on the existing car park, and north of the IER admin building on a vacant block). The final siting location and building layout will be finalised during further conceptual design development following review of the overall master planning of 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.

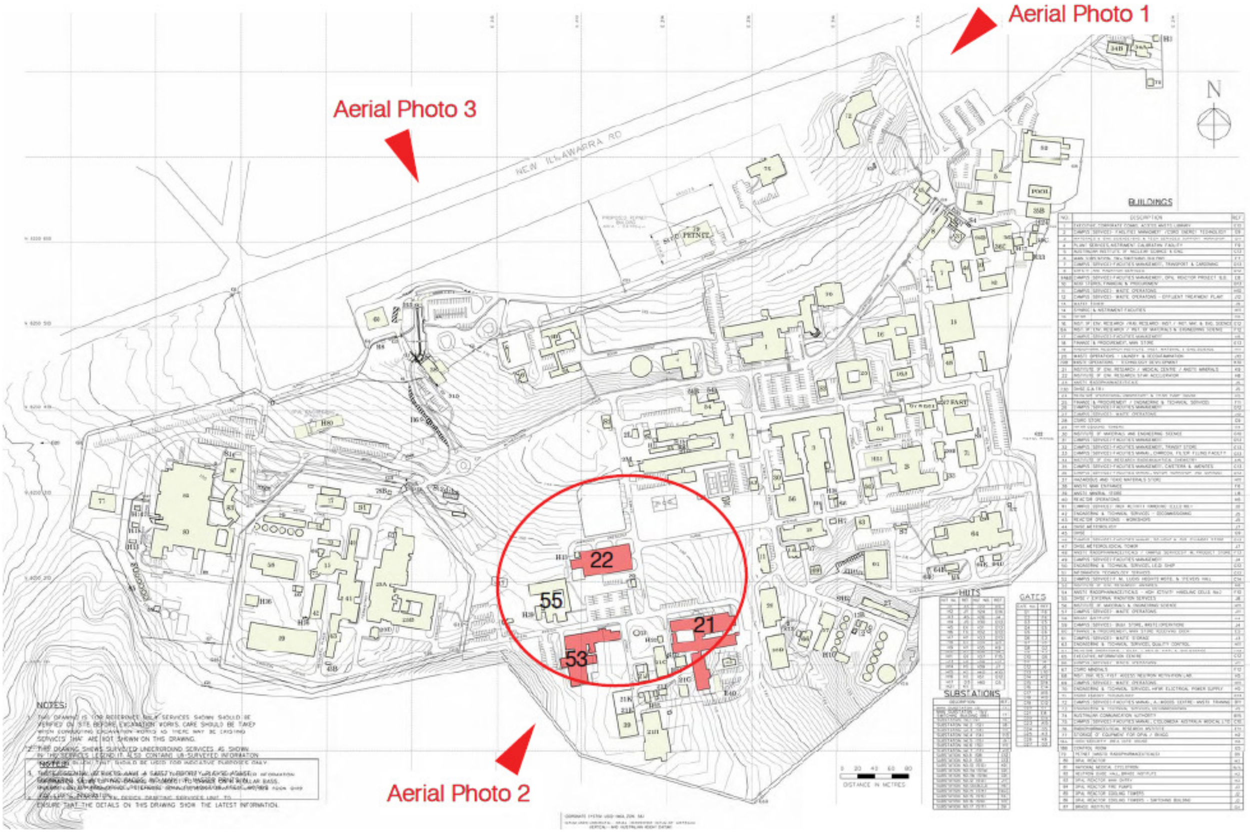


Figure 3: Overall Site Plan – CAS Facility Location

Figure 4 – Aerial Photo 1

Figure 5 – Aerial Photo 2

Figure 6 – Aerial Photo 3

2.4 Site Description

The proposed site is contained within ANSTO's Lucas Heights fenced campus on an elevated area known as the Woronora Plateau (mean altitude of 155 AHD – Australian Height Datum). The plateau is dissected by rivers and streams, including the Woronora River and several tributaries, which trend approximately north-northeast. They are incised to 100-120 m below the plateau and are associated with steep sandstone escarpments.

The proposed sites for the facility are bordered by the existing accelerators STAR (Building 22), ANTARES (Building 53) and Institute for Environmental Research Administration buildings, as shown in Figure 1.

The topography of the site falls from west to east at a slope of about 3 degrees. Geological sheets and previous investigations indicate the site and its vicinity are underlain by Sydney Sandstone. The soil profile comprises shallow sandy soil derived from the underlying sandstone.

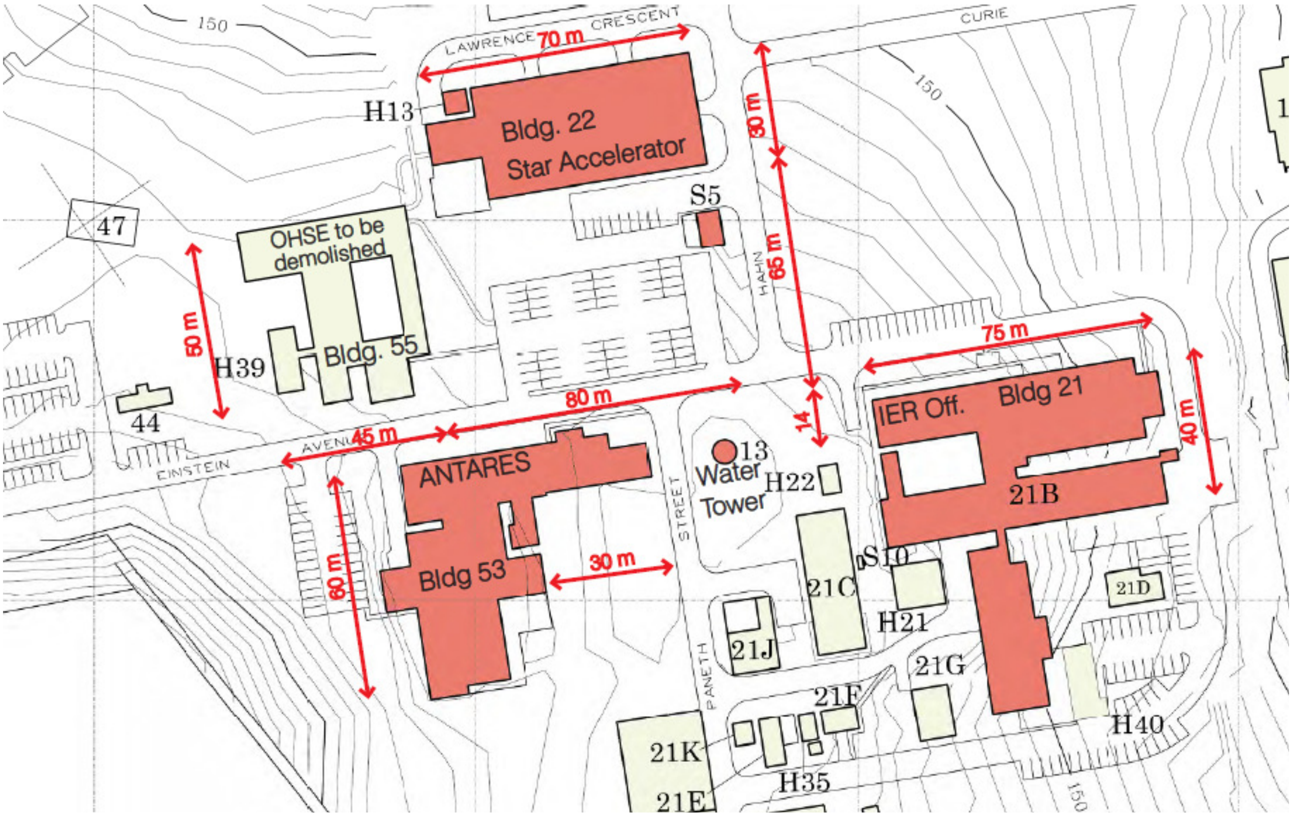


Figure 7 – CAS facility general location detailing associated building numbers and site contours

2.5 Information on Zoning and approvals

Land Acquisition

There is no requirement for acquisition of additional land.

Local Planning

The ANSTO lies within the local government area of Sutherland Shire Council. ANSTO is zoned 5(a) – Special Uses (Research and Technology) under the provisions of Sutherland Local Environmental Plan, 1993 as amended by Sutherland Local Environmental Plan No. 50. The term 'Special Uses' zone is generally applied to land set aside for community and Government uses.

Pursuant to Section 7A of the *Australian Nuclear Science and Technology Organisation Act* 1987, ANSTO is exempt from the application of State or Territory laws where those laws relate, among other things, to the use of land.

2.6 Details of applicable codes and standards

The works shall be undertaken in accordance with all relevant Australian Standards and Regulatory Bodies, as noted in ***Appendix G.***

2.7 Planning and Design Concepts

2.7.1 Introduction

The creation of an identifiable building or area of buildings will be known as the “Centre for Accelerator Science” facilities. The Centre will incorporate new accelerator facilities, two new accelerators, new AMS & IBA beam lines, some existing accelerator equipment, new and existing offices and new laboratories.

The design of the CAS will be in accordance with Australian Standards and Building Code of Australia with a goal of delivering a reliable and maintainable facility. ANSTO standards will also apply where practical.

The design of the facility will be in accordance with best practice for office buildings. ANSTO is subject to Commonwealth environmental requirements, and sound environmental management is integral to the development of the CAS. A major objective is the achievement of a 4.5 star rating under the National Australian Built Environment Rating System (NABERS) through environmentally sustainable design.

The design for the CAS facility will portray an Iconic facility. It will be useful, functional, interactive, and space optimised. The design of the facility will be cost effective and reflect a constructability aspect. As part of the design process, the layout area and foundation for the facility will based on minimal cost, and once selected, then be built upon and equipped as needed with both energy efficient designs to increase the green start rating and architectural features for overall appeal of the building/s.

The building location will create a research precinct onsite, increasing efficiency of operations.

2.7.2 Design Philosophy

The proposed Centre for Accelerator Science will reflect the importance of ANSTO to the medical, scientific and general community and provide an efficient and aesthetically pleasing facility befitting a large and active prestigious international research facility. The CAS facilities will be functional and architecturally impressive, and of a style commensurate with ANSTO’s standing in the community. It will be attractive to those who use it and those who may visit it.

Particular attention will be given to the use of interior space as a modern open floor plan with designated zoned design elements. The facilities will incorporate natural light as applicable and provide meaningful views out that encapsulate the surrounding & internal works areas as well as affording a sense of orientation and easy access to all related facilities.

The design will respond to the local climate conditions as well as providing a welcoming presence indicating openness and accessibility. Appropriate passive design elements shall be incorporated to mitigate work areas negative impacts. The design of the new Facilities will take into account the use of the building and the types of services to be provided therein.

2.7.3 Materials and Finishes

The types of materials to be proposed for the construction will be cost effective, high quality, robust and low maintenance, and will contribute to the overall physical impression and attractiveness of the Facility.

Surface treatments and applied finishes will be durable, longwearing, low maintenance and will also be visually appealing. Preferences shall be given to finishes that are repairable on site as surfaces will be subjected to continuous hard wear.

2.7.4 Planning and design success factors

The project will incorporate the following key design success factors:

1. An architecture that reflects the buildings function as the Centre for Accelerator Science;
2. A design solution that clearly identifies and provides easy access to all functional elements of the facility, and neighbouring facilities such as STAR, ANTARES and the Institute for Environmental Research administration building;
3. A facility envelope that is based around the two new accelerators allowing for visitors to view the equipment without disturbing the working staff;
4. The ability to maximise and take advantage as much as possible the use of natural light;
5. An energy efficient and low maintenance design outcome for the facility;
6. Minimum risk in relation to security, OH&S and public safety within the facility;
7. A cost effective building with a high degree of "constructability";

2.7.5 Floor Area

The proposed development will comprise a floor area of approximately 4,950 square metres, made up of 2,500 square metres for Accelerator facilities, 2,000 square metres for AMS chemistry facilities, 100 square metres for communal office space, and 350 square metres for the Uranium Series Laboratories. This includes accelerator halls, beam rooms, laboratories, offices and service rooms.

These floor areas a detailed below.

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	230	230	Compact Accelerator & beam lines
3. Loading Bay	1	26	26	Undercover with crane access
Storage				
4. Components store	1	30	30	Accelerator spare parts and equipment
5. Consumables store	1	20	20	Electrical wiring, fittings, hoses, tubing and other common materials
6. General materials storage	1	0	0	General infrastructure and ANSTO spares – Store in current facilities
7. Flammable liquids, gases and chemical storage	1	25	25	Compliant storage areas at rear of facility
Offices				
8. Technical library	1	25	25	Documentation, drawings and maintenance logging
9. Control Room	1	45	45	control computers and

Accelerator facilities	Qty	Area sqm	Total sqm	Comments
				instrumentation
10. Staff Offices (individual)	3	12	36	Tech leader and 2 accelerator scientists (IBA)
11. Staff Offices (shared, 2 persons each)	3	16	48	4 tech staff, 1 postdoc + visitor
12. Overnight rest area	1	8	8	
Laboratories / Service Rooms				
13. Electronics/Electrical lab	1	45	45	Maintenance & development
14. Vacuum repair & maintenance lab	1	35	35	Repair & maintenance
15. Mechanical lab	1	35	35	Maintenance & development
16. Ion source mounting lab & archive	1	25	25	cathode mounting and archiving
17. Ion source cleaning lab	1	20	20	cleaning and storage
18. AMS Electronics instrumentation & detector service	1	25	25	storage, servicing and repair
19. Sample mounting, control & data acquisition - IBA	1	20	20	mounting samples prior to measuring
20. Ion Implantation and sample preparation - IBA	1	30	30	locate equipment associated with the preparation of samples
21. IBA Electronics instrumentation & detector service	1	25	25	storage, servicing and repair
22. Small accelerator lab	1	35	35	sample mounting, accelerator component adjustments and repair
Facilities				
23. Server/Computer room	1	0	0	IMS hub – place in control room
24. Foyer/Display Area	1	180	180	Entrance & display
25. Gas Handling Plant	1	35	35	Equipment associated with the transfer of gases to and from 6MV
26. Accelerator General Plant Area	1	35	35	Mobile SF6 gas handling, compressed air, & associated Accelerator equipment
27. Conference / Meeting Room	2	20	40	Large conference / meeting rooms
General Plant				
28. Cleaners	2	8	16	Cleaners Rooms
29. Amenities	2	30	60	Male, Female, Disabled, Showers
30. Utility room	1	15	15	Mail / Print / Fax / Copier
31. Kitchen	1	40	40	Building Tea Room
Total required area			**2059**	
Internal circulation	15%		309	
ACCELERATOR FACILITIES GROSS AREA			**2368**	

*Assumed general plant areas would use existing parts, roof spaces or combined AMS facility as needed.

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

AMS Chemistry Facilities	Qty	Area sqm	Total sqm	Comments
Offices				
3. AMS Chemistry Leader	1	16	16	
4. Team Leaders	3	12	36	3 staff
5. Radiocarbon Teams	3	72	72	9 staff
6. Radiocarbon Researchers	2	12	24	2 staff
7. Stable Isotopes/ GC/LC + development staff	1	32	32	4 staff
8. Post-docs offices	1	16	16	2 postdocs
9. Cosmogenics Isotope Team	1	32	32	4 staff
10. Visitors office	1	32	32	4 visitors
Laboratories / Rooms-Carbon				
11. Quarantine lab	1	44	44	AQIS approved quarantine premises
12. Dirty pre-treatment lab	1	22	22	Crushing, grinding, milling, jet abrading etc
13. Main pre-treatment lab	1	65	65	Sample pre-treatment (wet chemistry)
14. CO2 conversion lab (ISO Class 7)	1	87	87	Convert water, combustion & hydrolysis samples to CO2
15. Graphitisation lab (ISO Class 7)	1	65	65	Converts CO2 to graphite
16. Cathode loading lab (ISO Class 7)	1	8	8	Loading FP and RP cathodes
17. Low background lab (ISO Class 7)	1	14	14	Combust, graphitise and cathode load low level samples
18. Stable isotope GC/LC lab + balance room (ISO Class 8)	1	65	65	Measuring stable isotopes (C, N),SI weighing area, GC/LC/MS + Mat 253/kiel device
19. Development lab (ISO Class 7)	1	44	44	Experimental development (CO2 from air, laser graphitisation, in-situ C14 & other)
20. Equipment development lab	1	22	22	Develop and maintain electronics and equipment
21. Storeroom + Refrigerated Room	1	44	44	Storage of refrigerated non quarantine samples + Storage of lab supplies, sample & graphite archive and records
Laboratories / Room- Non-Carbon				
22. Storeroom	1	22	22	Storage of lab supplies, samples and files
23. Multi-purpose shared lab (ISO Class 8)	1	44	44	Dissolution & processing chlorine, hot iodine, new isotope lab, balance room & cathode loading
24. Actinides and iodine lab (ISO Class 7)	1	65	65	Processing of actinide and iodine samples
25. Cosmo balance room (ISO Class 7)	1	11	11	Weighing of Be and Al samples
26. Cosmo cathode loading (ISO Class 7)	1	11	11	Cathode loading Be and Al samples
27. Cosmo column lab (ISO Class 8)	1	54	54	Column chemistry and calcining
28. Cosmo dissolution lab + balance room	1	54	54	Cleaning, ultra-sonication and dissolving samples, weighing
29. Heavy liquid / Frantz lab	1	11	11	Density and magnetic separation
30. Acid lab	1	33	33	Sample cleaning using phosphoric acid and Aqua regia
31. Cosmo rock crushing and sieving (needs outside doors)	1	33	33	All in one crush and then sieve rocks
32. Cosmo sample sorting	1	11	11	Storage and selection of samples

AMS Chemistry Facilities	Qty	Area sqm	Total sqm	Comments
Facilities				
33. Network Room	1	0	0	IMS – Share
34. Entry/Foyer	1	0	0	Entrance Foyer – Share
35. Meeting Room/s	1	16	16	Share large divisible conference room
36. Cleaners	1	0	0	Cleaners Room – Share
37. Amenities	2	0	0	Male, Female, Disabled, toilets & showers - Share
38. Utility room	1	0	0	Mail / Print / Fax / Copier – Share
39. Workshop	1	20	20	Building workshop area
40. Kitchen	1	0	0	Building Tea Room - Share
41. General Plant *				
Total required area			**1150**	
Internal circulation		20%	230	
AMS CHEMISTRY FACILITIES GROSS AREA			**1380**	

* Assumed General mechanical plant areas would utilise space above graded laboratories.

Table 3 – Combined AMS Facilities

Office space for people directly associated with **both** Facilities

AMS Office space *	Qty	Area sqm	Total sqm	Comments
1. Offices	2	16	32	AMS senior scientist + two post-docs
2. Offices	3	12	36	2 AMS scientists + visitor room
TOTAL			**82**	

* Assumes incorporation with facilities for the purpose of providing usual amenities.

Table 4 – Uranium Series Laboratories

Uranium Series Laboratory Areas	Area sqm	Comments
General Area		
1.Main Workroom	18	For lead scientist Tezer Esat
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	**271**	
Internal circulation (20%*)	54	
Uranium Series Laboratories Gross Area	**325**	

The above areas are based on estimations, and are provided as a guide only. The design consultant as part of the preliminary design scope work will ratify and finalise each item area to meet the actual minimum needs.

2.7.6 Facility Requirements

Specific details of the required new laboratories, offices and accelerator facilities are contained in the following attachments;

Appendix D - “Building and Services Infrastructure Information for the New ANSTO Accelerators”.
Appendix E - “Building and Services Infrastructure Information for the New AMS Chemistry Facilities”.
Appendix F - “Uranium Series Laboratories (USL) general requirements”.

2.7.7 Accelerators

Although exempt from public works committee submission, the accelerator supply is being managed as part of the overall CAS project, with procurement dependent on PWC approval. Although the selection of a preferred supplier for the equipment has not been made, the facility design at this stage is required to comply with the minimum requirements of the available suppliers for both accelerators.

In summary, the two proposed accelerators include:

1. A new Compact 1MV AMS system, primarily used for radiocarbon and actinides analysis but capable of a wider range of isotopes as required. This system will offer significant advantages compared to ANSTO’s existing capabilities. It will have greatly improved sensitivity and operational efficiency for actinides analysis. Radiocarbon analysis will be performed with higher efficiency and throughput. Analysis of small carbon samples in both solid and gaseous form will be possible.

2. A 5-6MV tandem accelerator capable of providing a wide range of heavy ion beams, as required for a flexible program of research based on AMS and IBA capabilities, and able to support research into radiation effects of interest in medical physics and other applications. This accelerator will be a modern, low maintenance machine, built to ultra-high vacuum standards, thus enabling high analytical sensitivity and reliable operation.

2.7.8 Civil and Structural

The building foundations will be designed for safe operation during seismic activity, vibrations, settlement and equipment loads over the life of the facility and are expected to be concrete column pads into bedrock.

Heavy shielding sections or pieces of equipment will be assessed seismically as per Australian Standards.

Consideration will be given to the principle of providing car parking on the periphery of the site as part of further concept development proposals. In the initial options proposed, the designers may consider re-locating car parking space to make way for the new development. To allow access for tour groups, the facility has a need for a bus turning and parking spot.

2.7.9 Hydraulic Services

The main supply of cold water for the CAS will be derived from the extension of the existing site wide water reticulation. Solar hot water heaters will generate hot water locally within the new areas to cater for change rooms, showers and sinks.

The new buildings will also necessitate additional stormwater control systems for existing drainage catchments, with implementation of contouring, bunds, retention ponds and stormwater litter collection. The system will be integrated into ANSTO's existing stormwater system. Measures to reduce water consumption include: water flow control tap ware, dual flush water closet pan cisterns, recycling reject water from water purification units and programmable boiling water units.

2.7.10 Mechanical Services

A significant component of the 4.5 star rating under the National Australian Built Environment Rating System (NABERS) can be achieved by a building and mechanical services design that incorporates specialised pressure regimes between the different areas.

The air conditioning to the various areas of the building will be provided by separate mechanical plants in order to ensure that efficiency is maintained between the different areas. Chilled water air handling units will be used for the cooling requirements of the air conditioning system, while the heating function will be met by using electrical heating systems. The air conditioning and exhaust systems will provide the required building pressurisation regimes.

2.7.11 Electrical Services

The facility will have four workspaces for electronics and electrical instrumentation repair and development. Each accelerator will also have significant electronics, which will be centralised and shared wherever possible. Each instrument will have its own dedicated earth, to prevent interference between instruments.

Each lab and work area will have local electrical isolation.

The electrical design will incorporate a standby generator or alternative standby supply such as a bank of UPS (uninterruptible power supply) units.

2.7.12 Fire Detection, Fire Alarm and Security Systems

The facility will fully comply with all relevant codes. This includes fire detection and fire alarm systems which will be installed and interconnected with the existing site wide system to ensure that the entire ANSTO complex operates as a single unit. Hydrant and hose reel systems will be installed throughout the new building in order to comply with the BCA.

The facility will include an integrated access control and building security system. This will uses card access with electric or magnetic door locks to control and monitor access through the facility. The ANSTO site itself has additional security requirements and access restrictions.

2.7.13 Communications

The existing telephone, computer networks, and the public address system will be extended to cover the new areas as required.

2.8 Acoustics

Acoustics throughout the building will comply with relevant Australian Standards as required. The equipment is not expected to generate excessive noise.

2.9 Water and energy conservation measures

The design of the building and equipment used therein shall comply with the Energy Efficiency in Government Operations (EEGO) Policy. The EEGO is the Australian Government's policy on energy efficiencies in Government Operations. The policy is administered by the Department of the Environment and Water Resources replacing the policy, Measures for Improving Energy Efficiency in Commonwealth Operations (1997).

It is ANSTO's objective is to design a building that will produce a rating of 4.5 stars for all three elements.

Water conservation measures will include:

- In ground large volume rainwater and RO reject water collection tanks
- AAA rated shower heads
- Auto sense taps 6-star rated (and soap dispensers)
- High water efficiency lab dishwashers
- 6L/3L half flush toilets
- Recirculated water chiller units for laboratory cooling use

Consideration will be given to the incorporation of passive energy conservation measures into the building and landscape design, and active measures into the design of the mechanical, electrical and hydraulic services to reduce energy usage. Measures to be considered will include:

- Screening of north-facing windows, to control solar heat gains;
- Shading to the east and west windows, to control solar heat gains;
- Thermal insulation, to reduce heating and cooling loads;
- Significant daylight incorporated into the design, to minimise the use of artificial lighting;
- IR movement sensor controlled room lighting;
- A building management system to operate, control and monitor engineering services;
- Timers to shut some air conditioners right down at night/weekend;
- Timers to shut down some air conditioning compressor (only) at night/weekend;
- Variable speed drives for all variable air volume handling plant and secondary chiller water and heating water pumps;
- Installation of bike racks to encourage riding to work to reduce greenhouse gas emissions;
- Use of long life low energy light fittings;

2.10 Master planning and site planning considerations

The facility will be incorporated within the current ANSTO Site Master Planning, and will adopt the following objectives;

1. To develop a 'forward thinking' building for science research that is benchmarked against global best practise and equal to international standards in innovation, design excellence and sustainability.
2. To deliver a building in its adoption and implementation of ESD initiatives including; energy efficiency, indoor environmental quality, water management, materials selection and emissions reduction.
3. As a core component of the ANSTO family the new facility is to play a critical part in attracting local and world class researchers; interfacing with public and private research projects and interacting with key educational establishments.

4. The new facility is to comply with the principles adopted current Asset Master Plan for the ANSTO Campus in particular those of staging and location.

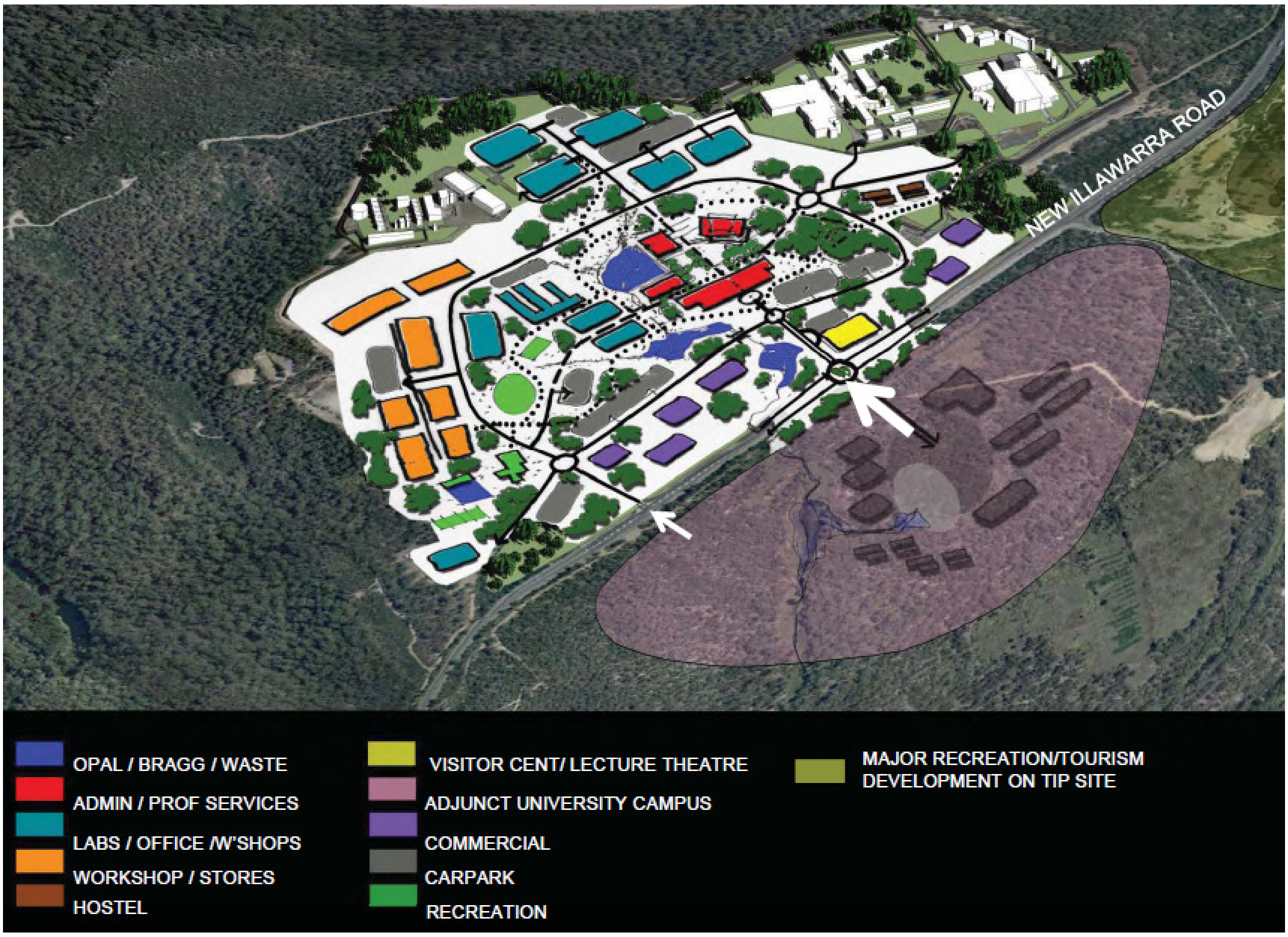


Figure 8 – Current Master Plan Study being developed

2.11 Provisions for people with disabilities

The access route to and through the building will be compliant with all standards and codes for disability access, ensuring comfortable movement to, from and between the facility for all users. A DDA consultant will be engaged as required.

2.12 Heritage issues

There are no heritage issues raised for this project at present.

2.13 Child Care Provisions

As a scientific nuclear facility, ANSTO does not currently offer internal childcare facilities, although some early planning has recently been undertaken to investigate the feasibility of developing this. Several external facilities are available in the neighbouring suburbs outside the buffer zone in Menai and Engadine and Heathcote.

2.14 Fire protection and security measures

Fire detection and fire alarm systems will be installed and interconnected with the existing site wide system to ensure that the entire facility operates as a single unit. A reliable, networked Fire Indication Panel will be installed in the facility, and linked back the Site Control Centre. From this centre, emergency personnel have remote access to the fire system for the whole ANSTO site. The system at a minimum will comply with all relevant standards and codes.

There will be a building security system installed, with card access to control and monitor access to certain physical containment (PC2) laboratory areas, via electric or magnetic door locks as required.

2.15 Occupational health and safety measures

Accelerators
The safety and environmental issues of the new particle accelerators will be similar in nature to those that exist for the currently operating accelerators.

Basic Safety and Health Considerations
- Specifically work processes for accelerator activities
- Identify and analyze hazards of accelerator and associated operations
- Provide opportunities for employees to give feedback to management regarding improvements to accelerator operations and controls.
- Train employees based upon the particular hazards identified and use competent instructors to provide training.

Specific OH&S Considerations
- Electrical hazards
- Control of hazardous energy
- Egress and fire protection
- Lasers
- Ionising radiation hazards
- Non ionising radiation Hazards
- Ventilation systems

ARPANSA has the authority to regulate the OH&S hazards that are associated with the operation of particle accelerators and incidental radioactive material produced by particle accelerators. As part of the license application ANSTO must provide ARPANSA with:
- Effective Control Arrangement Plan
- Safety Management Plan
- Radiation Protection Plan
- Security Plan
- Emergency Plan

Prior to submissions to ARPANSA, ANSTO conducts a rigorous internal analysis on the requirements safety and environmental issues, by a group called the Safety Assessment Committee (SAC).

Facilities
A formal Safety & Environmental Plan will be submitted by the Contractor prior to handover of the site. This will be reviewed by a ANSTO Health & Safety Rep and ANSTO Engineering to comply with best practice, codes, regulations & standards.

The Contractor will be regularly monitored to ensure compliance with this plan. Any breaches of this will be formally reported at Project Meetings for assessment & action.

2.16 Landscaping

Landscaping plan shall use native flora to the area with a design basis for low maintenance. Irrigation systems will be planned around the site using rainwater harvesting. The overall landscaping will be finalised in order to meet with ANSTO's Site Master Planning for the surrounding precincts.

2.17 Consultation with Relevant Authorities

ANSTO will consult with the Australian Safeguards and Non-proliferation Office (ASNO) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) with regard to security and safety matters.

There will be ongoing consultation with employees. ANSTO has a number of occupational health and safety workplace committees and various mechanisms for consultation with unions, including a 'peak council' on which management and union representatives meet to discuss issues.

ANSTO's Engineering and Technical Services Major Projects Delivery office will be responsible for the overall management of the project, from the development of the concept design through to final completion and commissioning. External consultants will be engaged to carry out the design development and detailed design. Procurement for the construction will involve tender action in accordance with the Commonwealth Procurement Guidelines.

A security review of the LHSTC was undertaken by the Australian Security Intelligence Organisation (ASIO) which noted that ANSTO continue to consult with ASIO on security matters in relation to the proposed works. Due to the nature of the proposal, consultation will be required with ASIO or designated security consultants. ANSTO will work closely with the principal design consultants and ASIO to ensure that the proposed design is in accordance with government security requirements. Consultations will also take place with the Australian Safeguards and Non-Proliferation Office (ASNO) as required.

2.18 Impact on the local community

Given the isolated location of the ANSTO site, there will be minimal to nil disruption to the local community during the construction period.

After completion the facility it is envisaged to require an additional 17 staff, increasing up to approx 30 over the next five to ten years. These staff will be fully housed within the ANSTO site. These people may be recruited from the local areas.

The construction period will also take approx 15 months to complete. During this period numerous opportunities will be available for local companies to undertake works for the engaged principal contractor.

Construction work is scheduled to be undertaken during normal construction working hours, and not at night or on Sundays. The noise generated should be no different to current activities on the site, with industry standard civil and structural works taking place.

2.19 Details of the project delivery system

The accelerators being procured as part of the CAS project will be based on available standard type systems but each will be customised, particularly the beamlines and larger unit, to meet ANSTO's specific user requirements, that will require detailed design development prior to fabrication commencement.

The overall facility will be designed and developed from first principals using external design consultants, and then constructed for fit out and commissioning of the accelerator equipment by a suitably qualified head contractor.

Accelerator science is not new to ANSTO, despite the project delivering new systems, services and capabilities. The overall facility, including accelerator and AMS chemistry laboratories will be developed using the operating and maintenance experience available at ANSTO and also on what has been done at similar leading overseas facilities.

The overall CAS project will be managed as a program of works, with separate project managers or engineers engaged to manage the sub-projects within the program of work. These project managers will report to the program manager but will have separate clients as required for the given work scope.

The project will be undertaken using a phased approach over the project's lifecycle stage gates and capital investment approvals. It will be managed in accordance with ANSTO's Project Management Methodology Handbook. This allows for controlled progression of activities at crucial points. Although serial lifecycle planning is used, there will be many opportunities to plan parallel activity to expedite the works, and thus manage schedule constraints appropriately.

It is planned to design, construct, install and commission the two new accelerators and beam lines in parallel. Similarly, the design and construction of the new facilities will be in parallel to the design and fabrication of this equipment, with accelerator suppliers based abroad.

The Project team needs to carefully consider the long term operational requirements of the facility, and compatibility of new and old equipment. This will be addressed in the user requirements specifications, during tender evaluation and selection, and during detailed design development.
The CAS Program will rely on the expertise of the Institute for Environmental Research's scientific and engineering staff, Engineering and Technical Services specialists, Major Projects Delivery Office Managers Engineers & Supervisors, plus experienced external consultants, as required. The Institute for Environmental Research has taken the following actions to ensure the project is adequately supported:

i) Engagement of Engineering & Technical Services MPDO for the overall Project Management.
ii) Commencement of the hiring process for key personnel.

The uncertainties/unknowns of the project (and how to manage these) are identified in the project's detailed risk register/management plan.

2.20 Construction program and/or project schedule

A preliminary project schedule is attached in **Appendix H**. The dates in this schedule have been used to derive the milestones detailed in the EIF agreement. Exact construction dates to meet these broader goals will be largely based on the style of construction contract used, and the facility design selected.

2.21 Associated plans and drawings

Facility design documents are currently being developed to meet the requirements of the the design principles noted throughout this document. This is being carried out by architectural design consultants under a preliminary design work scope. Their scope of work includes concept design development, with some associated plans and drawings attached in **Appendix I** . phase.

3 CONCLUSION

This submission illustrates the need for the Centre for Accelerator Science to enhance Australia's accelerator based research capabilities and student/researcher access to world-class infrastructure. The Centre for Accelerator Science offers a solution to this need.

APPENDIX A- CAS Project Plan Milestones extract from EIF Agreement

No.	Milestone	Completion Dates
Milestones to 30 September 2009		
	<u>Centre for Accelerator Science:</u> Management and governance structure development Prepare preliminary schedule for construction of building and procurement and installation of accelerators Prepare preliminary budget	September 2009
Reporting		
	Submission of Milestone Report 1	**1 October 2009**
Milestones to 31 December 2009		
	<u>Centre for Accelerator Science:</u> Issue Project Management Plan Establish technical and engineering teams, including commencement of recruitment as necessary Finalise functional requirements and prepare consultancy brief Commence requirements definition for 5MV Tandem accelerator Conduct tender process and engage design consultant for facilities preliminary design Finalise Gas-Filled Magnet (GFM) specifications and tender for preferred supplier Commence requirements definition for Microprobe Develop facilities User Requirements Specification (URS) Commence requirements definition for 1MV Compact accelerator Commence drafting Public Works Committee submission	October - December 2009
Reporting		
	Submission of Milestone Report 2	**31 December 2009**
Milestones to 31 March 2010		
	<u>Centre for Accelerator Science:</u> Finalise IER recruitment Phase 1 Building concept development / options review Geotechnical investigations of preferred site Commence facility preliminary (Initial) design Finalise GFM design & deliverables Procure GFM & associated components Commence tendering for 5MV Tandem accelerator preferred supplier Commence tendering for Microprobe preferred supplier Commence tendering for 1MV Compact accelerator preferred supplier Submit Public Works Committee submission	March 2010
Reporting		

No.	Milestone	Completion Dates
	Submission of Milestone Report 3 (and Annual Business Plan 1)	**31 March 2010**
Milestones to 30 June 2010		
	<u>Centre for Accelerator Science:</u> Complete facility preliminary design Issue preliminary cost planning for facility Finalise Environmental planning assessment Commence preparation of documentation for ARPANSA Site licensing GFM alignment and construction GFM services works Prepare detailed design consultancy brief for building Commence tendering for building detailed design consultants Commence design finalisation for 5MV Tandem accelerator Commence design finalisation for Microprobe Commence design finalisation for 1MV Compact accelerator	June 2010
Reporting		
	Submission of Milestone Report 4	**30 June 2010**
Milestones to 30 September 2010		
	<u>Centre for Accelerator Science:</u> PWC approval Internal review of draft site licence application Submit site licence application to ARPANSA Commission GFM beam-line Engage facility detailed design consultant Commence facility detailed design Commence Preliminary Safety Analysis Report (PSAR) Procure supply of 5MV Tandem accelerator Procure supply of Microprobe Procure supply of 1MV Compact accelerator	September 2010
Reporting		
	Submission of Annual Report 1 (including Milestone Report 5)	**30 September 2010**
Milestones to 31 December 2010		
	<u>Centre for Accelerator Science:</u> ARPANSA site licence granted GFM Acceptance Testing GFM Qualification and finalisation	December 2010
Reporting		
	Submission of Milestone Report 6	**31 December 2010**

No.	Milestone	Completion Dates
Milestones to 31 March 2011		
	Centre for Accelerator Science: Finalise building detailed design Finalise cost planning for facility in order to secure internal approval for contractor engagement Finalise Construction brief & tender documentation for building Prepare ARPANSA construction licence application	March 2011
Reporting		
	Submission of Milestone Report 7 (and Annual Business Plan 2)	**31 March 2011**
Milestones to 30 June 2011		
	Centre for Accelerator Science: Internal assessments of construction licence application Submit construction licence application to ARPANSA Commence tendering for building head contractor	June 2011
Reporting		
	Submission of Milestone Report 8	**30 June 2011**
Milestones to 30 September 2011		
	Centre for Accelerator Science: Complete Fabrication of Microprobe Complete Fabrication of 1MV Compact accelerator Microprobe Factory Acceptance Test (FAT) 1MV Compact Accelerator FAT ARPANSA Construction licence approval Engage facility head contractor for construction works Commence site mobilisation for building construction Commence bulk earthworks for facilities construction	September 2011
Reporting		
	Submission of Annual Report 2 (including Milestone Report 9)	**30 September 2011**
Milestones to 31 December 2011		
	Centre for Accelerator Science: Commence foundation and slab construction works for building construction	December 2011
Reporting		
	Submission of Milestone Report 10	**31 December 2011**
Milestones to 31 March 2012		
	Centre for Accelerator Science: Commence Structural steel installation for facilities construction Commence internal linings for facilities construction Commence Gas, Electrical, Hydraulic, & Mechanical services	March 2012

No.	Milestone	Completion Dates
Reporting		
	Submission of Milestone Report 11 (and Annual Business Plan 3)	**31 March 2012**
Milestones to 30 June 2012		
	Centre for Accelerator Science: Commence fit-out Commence drafting of final safety analysis report (FSAR)	June 2012
Reporting		
	Submission of Milestone Report 12	**31 June 2012**
Milestones to 30 September 2012		
	Centre for Accelerator Science: Complete Fabrication of 5MV Tandem accelerator 5MV Tandem accelerator FAT Commence services fit out of the facilities Commence services commissioning of the facilities Commence facility final safety assessment	September 2012
Reporting		
	Submission of Annual Report 3 (including Milestone Report 13)	**30 September 2012**
Milestones to 31 December 2012		
	Centre for Accelerator Science: Practical completion of the facilities Commence Installation of 5MV tandem accelerator Commence Installation of 1MV Compact accelerator Commence drafting ARPANSA operating licence application	December 2012
Reporting		
	Submission of Milestone Report 14	**31 December 2012**
Milestones to 31 March 2013		
	Centre for Accelerator Science: Commence Installation of Microprobe Commence Commissioning of 1MV Compact accelerator Commence Commissioning of 5MV tandem accelerator Internal assessment of operating licence application	March 2013
Reporting		
	Submission of Milestone Report 15	**31 March 2013**
No.	**Milestone**	**Completion Dates**
Milestones to 30 June 2013		
	Centre for Accelerator Science: Commence Commissioning of Microprobe Submission of Operating licence application to ARPANSA	June 2013

Reporting		
	Submission of Milestone Report 16	**31 June 2013**
	Submission of Final Report	**31 March 2014**

APPENDIX B- External Advisory Group Recommendations

<u>Centre for Accelerator Science project</u>
Report and Recommendations of External Advisory Group (EAG)
21 Aug 2009

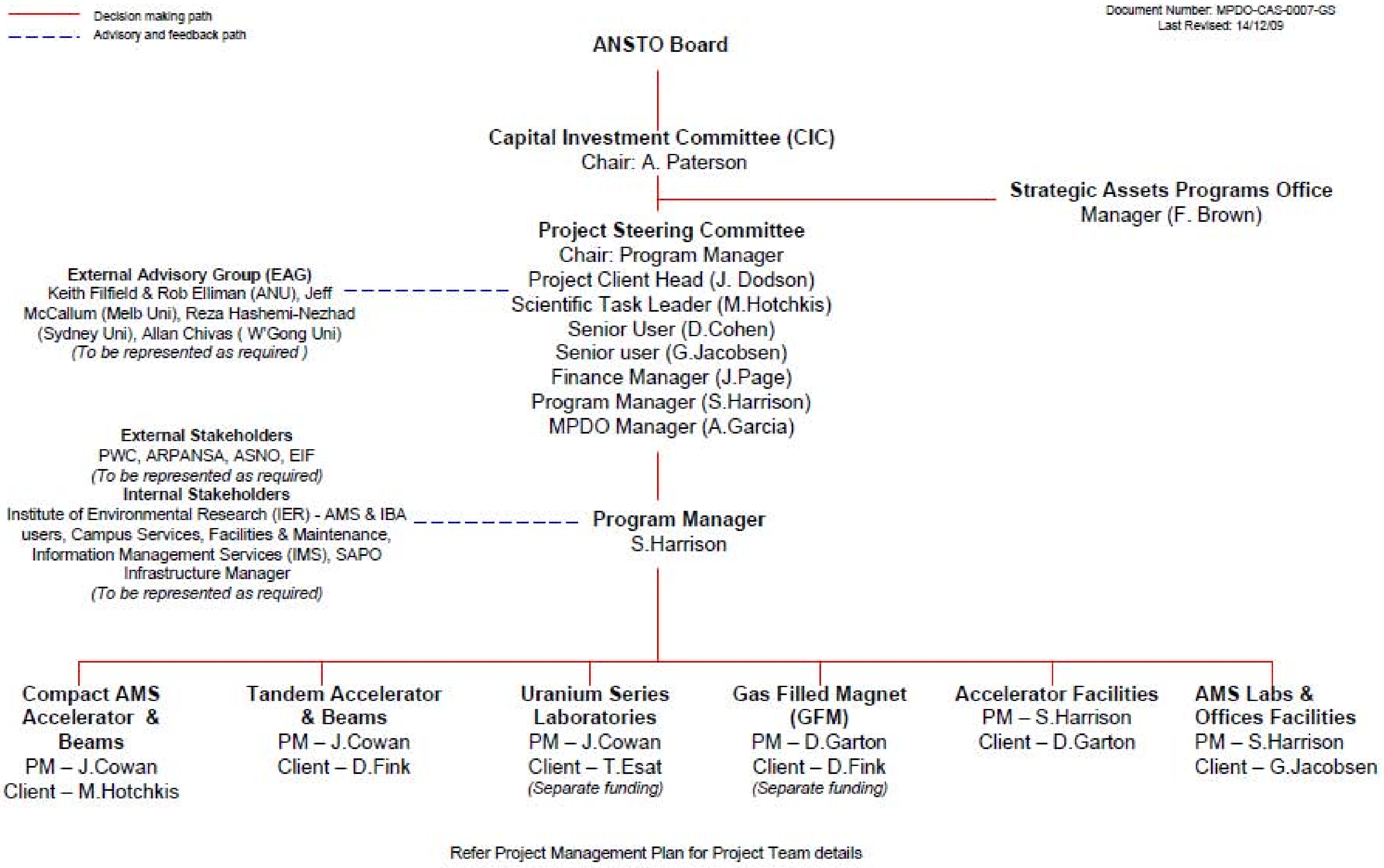
1. The EAG endorses the case outlined in the briefing document to purchase
    a. A 5-6 MV state-of-the art tandem accelerator for AMS and IBA. This would permit almost the full spectrum of AMS isotopes, including ^{36}Cl. It should be possible to have this system built and installed comfortably within the time frame of the funding provided that the crucial decisions are taken early in the process.
    b. A compact 0.5 – 1 MV AMS system. This would <u>not</u> be an off-the-shelf system, but would be specified for optimal performance for both radiocarbon and the actinides. Further, it would be specified with the flexibility to pursue new concepts in isobar separation such as collision cells and resonant laser ionization.
2. Two international trends in AMS can be identified. The first is the increasing capability of small accelerators for a range of isotopes. The second is an increasing number of larger accelerators in the 5-6 MV range which have capabilities that are significantly beyond the smaller facilities. The two proposed new facilities embrace both of these trends, and would allow optimal performance across the full range of isotopes as well as facilitating new developments. IBA will be well served by the complementary capabilities of STAR and the proposed 5-6 MV machine. The former is capable of servicing more routine demands using RBS-C, ERD, PIXE and PIGE while the latter extends these capabilities and provides an excellent platform for NRA and microbeam applications that would add significant capability to the environmental research programs at ANSTO. The extended Accelerator Centre would position ANSTO at the forefront of AMS and IBA laboratories worldwide.
3. The EAG further recommends:
    a. That ANTARES be retained as an operating facility but without significant investment, at least until the work load and performance of the new machines has been evaluated. The future of ANTARES should be reviewed on a 3-5 year time scale.
    b. That consideration be given to the use of ANTARES and/or STAR as an ion/neutron irradiation facility.
    c. That a staffing and management plan be developed that addresses both the ongoing needs of running the existing facilities and the additional needs associated with the purchase, commissioning and use of the new machines. This would include succession planning for key scientific and technical staff.
    d. That a discussion paper be developed to cover:
        i. A clear articulation of the scientific goals of the accelerator programs at ANSTO against the strategic plan of the division(s) involved and hence in relation to ANSTO's broad objectives. In particular, how will these new facilities position Australia at the forefront of the research areas pursued at ANSTO, and why is this strategically important for Australia.
        ii. Complementarity of the ANSTO facilities with other Australian facilities at ANU and Melbourne University.
        iii. The distribution of workload between the various machines, and in particular AMS usage of STAR
        iv. Opportunities for national and international collaboration and staff-student exchanges.
4. *A continuing role for the EAG*? The EAG considers that its role should be maintained for the benefit of providing a comprehensive and cohesive national approach to accelerator-based science. At a more detailed level, it would provide useful input and advice as the specification of the new systems and buildings proceed. It recommends regular meetings at 6 month intervals, with the flexibility to meet for special sessions if required.

We do not consider that the above role for the EAG requires international representation. ANSTO may, however, wish to seek input concerning the international implications and merit of the programs from a group of international advisers. Appropriate international advisers for AMS might be John Southon at UC Irvine who would bring a wealth of experience with both small and large AMS systems, and Stewart Freeman at SUERC in Scotland who runs a lab with both large and small AMS systems. An appropriate international advisor for the IBA program might be Barney Doyle at Sandia National Laboratories in the USA, or Frank Watt at the National University of Singapore.

Keith Fifield and Rob Elliman, ANU
Jeff McCallum, University of Melbourne
Reza Hashemi-Nezhad, University of Sydney
Allan Chivas, Wollongong University
28 August 2009

APPENDIX C- Project Governance Structure

PROJECT GOVERNANCE - Centre for Accelerator Science (CAS) Project



APPENDIX D- Accelerator Building & Services

Extracts of the Client's/User's **Building and Services Infrastructure Information <u>for the New ANSTO Accelerators</u>**

Scope

The following document is a collection of information to be considered in the *building and services specification* for the new accelerators. It does not include specific detail for civil works, décor or other aesthetic features that may be in a final design. It does make comment about provisions that must be considered for special accelerator requirements. It is based on operating and maintenance experience developed over 45 years at AAEC/ANSTO.

General Comment

An option is to locate the new accelerator facility in the vicinity of the existing B53 ANTARES and B22 STAR accelerator facilities. Co-locating the facilities will have the benefit of minimising the distance staff have to move between facilities however there are only minimal gains in infrastructure sharing as highlighted in this document.

Lessons learnt from operating two other major accelerator facilities have provided insight into the effectiveness or particular operational systems. From these experiences it is clear that there have been many mistakes made with the efficiencies in the current infrastructure design, in part due to financial constraints. While the less than satisfactory infrastructure appears to work well it is at the expense of maximising the effectiveness of staff to complete their work. It would be prudent to ensure that designs for the new facilities include measures that streamline the operational inefficiencies that currently exist.

Building

There are 5 main areas within the accelerator facilities that require different levels of consideration. Specialised rooms are discussed later in the document.

1. Accelerator Halls. These are the areas in which the accelerators and associated beam lines are located.
2. Technical work areas. These include engineering labs, workshops, work areas, library/drawing room, plant rooms, control room and store rooms.
3. Accelerator Users labs. These include sample mounting labs, special sample manufacturing labs, sample archives, and development labs.
4. Offices. Accommodation for accelerator personnel of mixed needs.
5. Common areas. Including conference/meeting rooms, toilets/showers, copy rooms, lunch room foyer and display areas.

Labs and Work Areas for the new accelerators

The following areas do not include common areas such as corridors, stairs, toilets, cleaners rooms, etc.

Electronics / Electrical Lab

Maintenance and development of electrical and electronic instrumentation for all accelerators in B53. Central to all facilities. It will have 4 workspaces for electronics and electrical instrumentation repair and development. HV testing area. Must have, antistatic benches, BAC style storage drawers and cupboards, direct access to store room, solder fume extraction over benches. Air conditioned.

Vacuum repair and maintenance lab

A dedicated vacuum lab to meet all of the B53 vacuum repair and developments. It will have multiple workspaces with integrated test beds. Access to all services including air, gas, water and chilled water. Cleaning area for pump parts. It must have an extraction manifold and hood for noxious gases. Limited storage will also be needed to accommodate the broad range of vacuum fittings and pumps. BAC styled storage. Deep sinks. Direct access to outside and close to workshop. Shelving to accommodate small pallets with heavy loads. Close to workshop.

Mechanical Lab

A dedicated semi-clean work area for the maintenance and development of accelerator components. Is not for vacuum system repairs. Central to all facilities. It will have 3 workspaces of mixed soft and hard wear benches. It will be a semi clean area for the in house repair and development of accelerator components for all accelerators in B53. BAC styled storage. Air and gas services and chilled water.

Technical Library

This room will serve two purposes. One, a library for all manufacturers documentation, engineering drawings and archived local information. Two, a maintenance logging room. Must have storage for plans and documents, computer (and printer), large table (for reading drawings) and chairs, white board. Located adjacent to control room. Should include an area to archive posters and historic material.

Control room

Control computers and instrumentation will go into this room. This room is not only for accelerator control but also plant process monitoring and limited plant control. It will be centred between both accelerators. Intended as a quite area for control and data acquisition and monitoring of plant performance. Suspended floor over service pit for cable access. Surrounded by glass windows facing towards work areas. Easy access from upstairs offices. Central hub for operations. Adjoining quiet room for operator comfort during out-of-hours operations.

Loading Bay

This undercover loading and unloading bay will adjoin the rear of the building with hard road access [to Paneth Street]. An overhead crane will facilitate movement of heavy items. It should be large enough to handle the movement of the largest new accelerator components. Must have room to store used pallets and long materials. Must have sufficient dust control to minimise dust spray into accelerator areas. Insulated roller door or equivalent to minimise heat load during summer.

Accelerator Components Store for 3 accelerators

This store will hold accelerator spare parts and assembly equipment. It will also hold accelerator equipment including spare electronics/electrical and mechanical instrumentation. BAC storage suites. Rack style storage. Must use floor to ceiling for storage so room for extensive racking is vital.

Consumables Store

Storage for electrical wiring and fittings, hoses, tubing and other materials commonly used. Will also accommodate general consumables for other functions. Rack style storage.

General Materials Store

This store replaces the store shed. It is not for proprietary accelerator spares. It will meet the needs of the general infrastructure and ANSTO designed spares. Includes a long materials rack and floor to ceiling shelving.

Ion source mounting lab and archive room AMS

Cathode mounting and archiving for used cathodes and other important samples.

Ion Source cleaning lab
Specifically equipped with cleaning equipment and storage for cleaned components. H/C water sink, gas, air, storage. Located adjacent to main ion source area.

AMS Electronics instrumentation and detectors service area and store room
For the storage of electronics instrumentation, radiation detectors and end-station equipment. Area for the servicing and preparing such equipment.

Sample mounting, control & data acquisition room IBA
Space for mounting samples prior to measuring on the accelerators. Storage for archiving samples. Room for data acquisition equipment, end station controls, computers. Storage for data acquisition electronics and other equipment. Suspended floor for cable access.

Ion Implantation and sample preparation room IBA
To locate equipment associated with the preparation of samples.

IBA Electronics instrumentation and detectors service area and store room
For the storage of electronics instrumentation, radiation detectors and end-station equipment. Area for the servicing and preparing such equipment.

Small Accelerator Lab
For work related to the smaller accelerator. Sample mounting, accelerator component adjustments or repairs.

Ventilated flammable liquids, gases and chemical store
Concrete, brick and stainless steel construction located at rear of facility but isolated from bushland to ensure minimal fire risk.

Server / Computer room
A hub for all accelerator computing systems throughout the new facility.

Gas Handling Plant
For equipment associated with the transfer of gases to and from the 6MV accelerator.

Accelerator General Plant Area Lower Floor
For mobile SF6 gas handling plant, back up compressed air supply, hoists, lifting frames for tubes and columns, equipment associated with accelerator maintenance supplied by manufacturers.

Accelerator Plant Room Upstairs
Chilled water plant, power distribution,

New Plant and Major Equipment

The list below includes items that are high cost and have high impact on the facility. For most of these items an individual specification may be necessary at a later date. The items relate to the building services and are not peripheral lab type items.

1. Chilled water plants – Essential. Cooling for accelerator components, pumping systems and high voltage power supplies. Dual system for breakdown redundancy. Plant should have extra capacity for future growth. Temperature adjustment and water treatment should be available to all maintenance including Acc Ops. Remote process monitoring in control room. Placed in parallel with ANTARES cooling loop as a back up.
2. Air conditioning plants/ventilation plants - Essential. Ventilation to include all labs and all underfloor ducting and voids. Uniform temperature and humidity with minimal dead airflow spots. Split system for breakdown redundancy. Ventilation should vent clear of building with minimal back streaming. Filtered.

3. Plant room to accommodate the above 2 items. Essential. Space is available above the ANTARES control room area in old B53. This is discussed later in this document.
4. SF6 Gas handling depot – Essential. Transfer of insulating gases between accelerators and storage vessels. If feasible a single plant should be purchased that can service both new accelerators. Transfer times should be capable of 1 day maintenance of accelerators. Consider non liquid storage.
5. Service gases depot – Essential. Storage and reticulation point for service gases. Space for at least 3 man pack capability and up to 12 gas cylinders storage. Remote pressure indication to control room. Isolation solenoids in all labs. Structured isolation points around facility. Road access for trucks and forklifts.
6. Site specific slabs with integral load piers. Essential. Each accelerator on its own structurally designed slab. Ducts and other service trenches to be cast within slabs.
7. Overhead service crane/s – Essential. Cranes above large accelerator, small accelerator and loading bay. They must be capable of lifting the single heaviest accelerator component with safety margin. Travel to extend full length of halls and bays with full travel to sides without obstruction.
8. Goods lift to second floor (if applicable) – Desirable. This will eliminate safety problems always associated with moving heavy goods upstairs when no ramp is available.

Existing Plant and Major Equipment

Plant and Equipment (P&E) and workspace that cannot be shared

1. The ventilation system provided for B53 provides circulation for the ANTARES target area building including the underfloor cavities. It was designed for active area ventilation but was never used for that purpose. Most of the plant is original with some refurbished equipment in use. As it was design for active filtration it is a dual system which is not required for a new accelerator facility. At sometime in the near future the system will require replacement.
2. The current chilled water plant has recently been upgraded to allow continual operation of the facility while the SF6 plant is operated. The plant has been duplicated with a parallel system so that one plant can be taken offline for repairs whilst the system still delivers full cooling capability. Extra load on this plant is limited and not available for the new accelerator facility.
3. Air-conditioning for B53 is divided into 3 parts. The original plant services the area in the ‘old’ B53 office area, labs and target area. Another plant located alongside the Tandem Hall services the hall only. Individual wall units service other offices and labs around the facility and boost cooling in ‘dead spots’ around the accelerator hall.
4. Communications equipment will have to be provided by ANSTO’s IMS. A paging system will be required in the accelerator halls and work area.
5. Limited space in the current gas depot will not hold sufficient supplies of gases for both accelerators and labs. This area may be built over in any case.
6. Although the SF6 gas handling plant can transfer large volumes of gas it cannot be located close enough to provide adequate line pressures and vacuums for complete transfer of the full gas load.

P&E and workspace that can be shared

1. Compressed air will be necessary for pneumatic equipment and ‘blow off’ cleaning. The building can be supplied via the back up compressor in B53. The compressor should be relocated to the upstairs building plant room.
2. Power currently comes in through the front of B53 running upstairs through the internal cavities. There may be adequate space to accommodate an extension of the power distribution from this point.
3. The B53 plant room if extended to utilise the full length of “old” B53 upstairs.

List of minor items to be considered

1. Building earthing philosophy (spark 'hardening' and decoupling of detector electronics)
2. Parking spaces
3. TV antenna
4. Wireless networking throughout building
5. Compactus
6. Direct access to labs at rear from office area
7. Consolidation of process controls and monitoring into control room
8. Computer networking. Wireless connection to Science Net
9. Visual cctv around facility for beamline and safety monitoring.
10. Building alarms central to control room
11. 2 cleaners rooms
12. Display area
13. Rear toilets
14. Upstairs toilets and showers (if applicable)
15. Production line-like Ion source maintenance area
16. LN2 free
17. Stores delivery area
18. Use of natural lighting
19. Upstairs tea room (if applicable)
20. Visitor talking area with lounges
21. Display area to be decoupled audibly from office area
22. Visitor facilities – 2 offices
23. Slab to be design to support weights up to the maximum individual component weight (probably the accelerator and magnets) along the beam line axis
24. All labs at ground level
25. Welding bay
26. Solvent cleaning bay
27. Lab coat cupboard
28. Air conditioning ducts in accelerator halls from ceiling not walls

Efficiency Points

1. Where feasible, plant and equipment should be purchased from reputable local suppliers to improve availability of servicing expertise and access to spare parts.
2. Consider purchasing 2 alike multicathode ion sources so that downtime due to scheduled maintenance or breakdown is minimised. All ion sources can break down!
3. Shared SF6 gas handling should be featured throughout the facility with a common storage area. This will make it cheaper, minimise safety issues due to leakage,
4. As much equipment as possible should be of similar brands and models including vacuum systems, power supplies, support electronics.
5. Oil free vacuum systems only.
6. Use as much natural lighting as possible throughout facility.
7. Support labs located near workshop at rear of facility. Technician's offices located closest to work areas.
8. Work area of accelerator to be on the same level as ANTARES. No steps. A goods lift may be used to move equipment and heavy goods to upper office level.

Detail of Inclusions for Specification

Floor

1. The main structural concrete slabs under the accelerator must be a single cast with integrated ducts/trenches included.
2. Main ducts from plant room areas to ducts around the accelerator perimeter. Other ducts as specified by manufacturer. Ducts to carry services, power, water, air, process gases, signals.
3. All duct covers made from steel and galvanised.
4. Floors painted with hard finish that can be repainted without need for pre-treatment.

Lighting

1. Natural lighting from overhead and where feasible through adjoining labs.
2. Over head lighting that is not on the centre line of the accelerator. Maybe lighting at an angle if necessary in order to make changing lights easier and less of a hazard.
3. Standby lighting to allow safe exit from any location in the hall.

Plant rooms

1. Option available for location above B53 control room in an extension of the existing plant room. Access to upstairs plant room from within the building or work area.
2. General plant room located at back of building. For SF6 gas handling and storage, compressed air, process gases. Direct access to rear plant room from outside.

Laboratories

1. Operations labs preference to be located at rear of B53 near to workshop and development lab (rm 0051).
2. Toilets in vicinity.
3. Windows also to face work areas so that entry into the room isn't necessary when looking for personnel.

Office and common areas

1. Offices and conference rooms, upstairs away from visitor areas.
2. Conference room large enough for at least 30+ people.
3. Visitor sitting area upstairs.
4. Upstairs toilets
5. Copy room
6. Lunch room towards rear with southern outlook
7. Stairs from office area direct to lab area at rear.
8. Outside lunch area with garden atmosphere. Covered area for BBQ. Shade sails as necessary.

Control Room

1. Accelerator control and data acquisition systems located within single control room along with process plant monitoring and control.
2. Control room located between accelerators.
3. A quiet room should adjoin the control room for out of hours resting.
4. Access from front of building.
5. Windows face towards accelerators.
6. Suspended floor with integral ducts radiating from room to accelerator areas.

Electrical Systems

1. Standby generator or bigger standby supply. Large UPS bank.
2. Local electrical isolation in each lab and work area.
3. Dedicated instrument earth.

Main Storage Area

1. Access to rear outside area and loading dock.
2. Adjacent to loading dock area and accelerator halls.
3. Outside doors must be insulated to ensure minimal heat load into building during summer.

General Building

1. Each accelerator should have its own dedicated hall with no overlapping beam lines or instrumentation cabinets.

2. All work areas must be located on the ground level to facilitate the efficient use of plant equipment and services. This would also apply to accelerator labs.
3. At least 3 metres clearance between beam lines and end stations to walls or significant building structures.

APPENDIX E- AMS building Services

Extracts of the Client's/User's **Building and Services Infrastructure Information**
for the New AMS Chemistry Facilities

Scope

The following document is a collection of information to be considered in the *building and services specification* for the AMS Chemistry facilities. It does not include specific detail for civil works, décor or other aesthetic features that may be in a final design. It is based on operating and maintenance experience developed over 17 years of AMS chemistry laboratory operations.

General Comment

The preferred option is to locate the new AMS chemistry facility in the vicinity of / as part of the existing Bld 53 ANTARES / Bld 22 STAR accelerator facilities.

Lessons learnt from operating the existing AMS chemistry laboratories have provided insight into the effectiveness of particular operational systems. From these experiences it is clear that there are structural design issues that happened during the refurbishment of the bld 16 AMS chemistry laboratories that are best avoided (like air conditioners on the roof, roof penetrations for fume hoods and air conditioning ducts…), these issues were caused in part due to the original financial constraints but are best avoided in any new building work.

Plant and Major Equipment

The list below includes items that are high cost and have high impact on the facility. For most of these items an individual specification may be necessary at a later date. The items relate to the building services and are not peripheral lab type items.

1. Chilled water plant – essential to supply recirculated cooling water for reflux condensers, Peltier chillers and steep profile furnaces (used in pre-treatment and graphitisation laboratories).
2. Air conditioning plants – essential to provide temperature controlled (sometimes humidity controlled as well) positive pressure ventilation in the AMS chemistry laboratories.
3. Clean room / HEPA filtered air conditioning – essential for some of the AMS chemistry laboratories to allow the processing of key AMS isotopes.
4. Recirculated water from Reverse Osmosis units – essential to provide feedwater to "Milli-Q" polishing units in the AMS chemistry laboratories and final rinse water for the laboratory dishwashers.
5. Service lofts above each laboratory area – essential to allow direct access (without entering the laboratories) to change fluorescent light tubes, HEPA filters, service fume hood fan motors etc. etc.
6. 2000L liquid nitrogen vessel and 240L liquid carbon dioxide dewar – essential, to provide liquid nitrogen, gaseous nitrogen for glove box purging and dry ice for cold traps.
7. Service gases depots – essential for the storage and reticulation of laboratory gas supplies.
8. Mono rail / chain block setups – essential to provide heavy lifting access to the service loft area(s).
9. External corrosives and solvent stores.
10. Building design to be planned to minimise bushfire risk, in particular ember attack.

Labs and Office Areas for the new AMS chemistry facility

It is planned that the new AMS chemistry facility will comprise two areas; laboratory (Radiocarbon and Non-radiocarbon) and office/common space. It is to be designed to accommodate the proposed expansion of sample throughput for the current suite of AMS isotopes, the provision of a multipurpose laboratory space for trialling other AMS isotopes and space for the staff required to accomplish this work. Also, allowance has been made for space to accommodate an increase in the number of visitors and post docs.

Office and common areas

It is proposed that the office area consists of seven 4 person offices, two 2 person post-doc offices and six 1 person offices. It is proposed that the common areas consist of a tea room, a dividable conference room that seats ~30 people (which splits into 2 meeting rooms), a mail/photocopier/printer room, cleaners room, IM room (power, phone & network), foyer (with HVAC display and fire panels), workshop and toilets - male and female (with showers and lockers), and disabled.

Note: The equipment / plant listed in the entries below, for each lab, is indicative only, it not meant to be a literal, absolute list. All labs will have the required positive pressure air conditioning / HEPA filtered class 7 or 8 clean room air conditioning capability as required. As well all fume cupboards will be of the correct type for the lab they are in and will have the appropriate HF or $HClO_4$ scrubber system if required. All balances will be housed on suitable balance benches and with cabinets as required. All labs will be supplied with all relevant gas supplies and fume cupboards will be equipped with suction outlets for vacuum filtration and nitrogen outlets where required. All labs will have appropriate corrosive and solvent storage cabinets as well as safety eye washes and showers. There will be external corrosives and solvent stores (24 m^2 total). There will be an external liquid nitrogen tank to supply liquid and gas, as well as a liquid carbon dioxide dewar to supply dry ice.

Radiocarbon area

1. Quarantine lab (2 areas – general/carbon and ice)

(A) General/carbon - a secure sample storage area, fridge and freezer. Fume cupboard, UV cupboard, autoclave, centrifuge, water bath, balances, water line, drying oven, HP water system, dishwasher, corrosives and solvent cabinets, and designated quarantine glass, sharps and waste bins.

(B) Ice – opens off area (A) – walk-in freezer (with window) containing a band saw, benches, ice-core racking and an ice grater. Laboratory area to also contain a -80 °C under bench freezer, two -20 °C chest freezers, ice melting flask, cupboards and bench space.

2. Pretreatment lab

File/sample pigeon holes, fridge, freezer, 3 fume cupboards, 2 centrifuges, water baths, 2 freeze driers, 2 balances, 3 drying ovens, 2 HP water systems, dishwasher and corrosives and solvent cabinets. Inner “dirty” lab with wood mill, powered mortar, ball mill, engraving area, shell / bone cleaning area (with dust extract), jet abrasive unit and dust extractor, old analytical balance and a top pan balance.

3. CO2 conversion lab

Fume cupboard, 3 CO2 transfer lines (2 combustion & 1 hydrolysis), 2 water lines, hydrolysis pumping line, combustion sample pumping line, 2 balances, water bath, oxy torch, 2 muffle furnaces, tube furnace, drying oven, HP water system and corrosives and solvent cabinets

4. Graphitisation lab

27 graphitisation lines, hydrogen alarm, balance, drying oven, HP water system, hydrogen alarm, fume cupboard and solvent cabinet. With two inner labs opening of it – (a) a loading lab containing 3 graphite loading stations and short term graphite storage, and (b) a low

background lab with the low background line, hydrogen alarm, drying oven, HP water system, fume cupboard and balance.

5. Stable Isotope and GC/LC lab
CN EA/CF-IRMS, Carbonate DI-IRMS, GC and/or LC, micro-balances, fume cupboard, drying oven and HP water system.

6. Sample development lab
CO2 from air line, 2 laser graphitisation systems, in-situ C14 line, hydrogen alarm, balances, loading station, furnaces, drying oven and HP water system.

7. Equipment development lab
He leak tester, pumping station, electronic test equipment, parts storage, soldering station with fume extract, hand tools, vice and scrap metal recycling bins.

8. Store room
Walk-in fridge (mainly for groundwater storage), access stairs to service loft, shelving and compactuses (for long term graphite storage, samples, files and laboratory supplies).

9. Workshop
Diamond saw, wood saw, sink, work bench with vice, lathe, drill press, oxy torch, various dust/fume extracts, metal recycling and workshop waste bins.

Non radiocarbon area

1. Store room
Shelving and compactuses for long term sample storage and to store files and laboratory supplies, and access stairs to service loft.

2. Multipurpose shared lab (high level iodine, high level beryllium and other isotopes)
Fume cupboards (including one HEPA), dishwasher, HP water system, 2 drying ovens, 3 furnaces and balances.

3. Actinides lab
Fume cupboards (with scrubbers), furnaces, dishwasher, HP water system, drying oven, balances, laminar flow cabinet, under bench fridge, centrifuges, and secure active sample storage. With a dedicated cathode loading and balance room.

4. Cosmogenic lab suite
(A) Short term sample storage and sorting room with shelving and bench / cupboard space
(B) Crushing and sieving lab with new all-in-one crusher plus two older crushers, 2 sieving setups, sink, drying oven and bench space (in a sound proofed, floating floor room) with external access doors.
(C) Phosphoric acid/aqua regia lab with two fume cupboards (one rated for perchloric acid), 2 fume extracts, 3 sinks, HP water system, drying oven and balances.
(D) Magnetic and heavy liquid separation lab with Frantz magnetic separator, fume extract, 2 sinks, balance and bench space
(E) Dissolution lab with fume cupboards (1 or 2 rated for perchloric), fume extracts, balances, HP water system, dishwasher, drying oven and sinks with a sound proofed ultrasonication lab (with fume extracts) for quartz cleaning, opening off it.
(F) Column / calcining lab with 4 fume cupboards (2 suitable for perchloric/HF, with scrubbers), dish washer, HP water system, drying ovens and furnaces. Opening off this lab are (a) a balance room and (b) a two station cathode loading lab with filtered cabinets and balances.

List of minor items to be considered

1. Computer networking. Wireless connection to Science Net and dedicated instrument data back up with an in-house network (mainly for IRMS, GC and LC instrumentation and graphitisation line data loggers).
2. Display boards in office hallway and foyer areas for AMS chemistry posters. Display boards in chemistry lab corridors covering sample processing (to help with explanations to visitors).
3. Service road giving access to rubbish, paper and plastic / glass recycling bins, gas cylinder drop off depot, corrosive and solvent stores, liquid nitrogen tank, liquid carbon dioxide dewar
4. High purity acid stills for nitric and hydrochloric acids in a dedicated fume cupboard in the lab where they are used the most.

Suggested Efficiency Points for consideration

Energy Conservation

1. Double glazing or low-e glass
2. Insulated walls, ceilings and possibly the slab (or slab edge)
3. Ground sunk/sourced heat pump air conditioning
4. IR movement sensor controlled room lighting
5. Light wells/skylights
6. Shade eaves
7. Ground sunk/source heat pump or solar with gas back up hot water heating
8. Timers to shut some air conditioners right down at night/weekend
9. Timers to shut down some air conditioning compressor (only) at night/weekend
10. IR sensor exterior lighting
11. High energy efficiency fluorescent lighting
12. Well insulated (floor/walls/door/ceiling) walk-in fridge & freezer units
13. Insulated recirculated hot water loop(s)
14. Instantaneous boiling water / chiller unit for tearoom with timer
15. External, adjustable blinds / louvres that shade the building windows
16. Solar voltaic panels and an inverter unit to provide some building power (1kW to 100kW depending on budget)

Water Conservation

1. In ground large volume rainwater and RO reject water collection tanks
2. AAA rated shower heads
3. Auto sense taps 6-star rated (and soap dispensers)
4. High water efficiency lab dishwashers
5. 6L/3L half flush toilets
6. Recirculated water chiller units for laboratory cooling use

Other measures

1. In ground marble acid traps for laboratory acid waste streams
2. In stack scrubber
3. In stack scrubber
4. Paper and cardboard recycling (tea room, printer room and offices)
5. Tea room plastic/Al/steel/glass recycling
6. Recycled paper in fax/printers/photocopier
7. Toner cartridge recycling box (in printer room)

It is intended to optimise water usage in the AMS chemistry area by installing dedicated water services, which minimise wastage, as below.

Install 6 separate water supply lines

1. Mains drinking water feeds
    - boiling water / chiller unit for tea / coffee
    - tearoom sink and dishwasher
    - toilet hand basins, and showers
    - laboratory sinks
    - main water feed for laboratory dishwashers

2. Recirculated mains hot water feeds
    - tearoom sink and dishwasher
    - toilet hand basins and showers
    - laboratory sinks

3. Recirculated reverse osmosis water feeds
    - supply water for all laboratory Milli-Q high purity water systems
    - final rinse water for all laboratory dish washers
    - make up water for the chillers
    - feed water for the air conditioner humidifier bottles

4. RO reject water feeds
    - toilet cisterns

5. Rain water feeds
    - supply grey water, landscaping drip feed garden watering
    - feed and return connections in fume cupboards for condensers

6. Recirculated chilled water feeds
    - laboratory feed and return connections for cooling Peltier chillers etc

APPENDIX F- Uranium Series Laboratories General Requirements

Introduction

A third area of the CAS facility, the 'Uranium Series Labs' is required to carry out mass spectrometry work, and to cater for future equipment purchases of Institute of Environmental Research (IER), ANSTO. A number of cleanroom facilities are needed, as well as workshop and office spaces to support these cleanrooms.

These laboratories will be similar to that of the CAS facility, hence significant cost savings may be achievable by adjoining the buildings. In saying this, the laboratories themselves will be functionally different, and should be separated in some way (either as a separate building using common services, a separate wing to the building, a separate floor to the building etc).

The Uranium Series Laboratories are a replacement of existing lab's at Australian National University, where one of the Mass Spectrometers (NG-61) are currently housed. This device will be relocated once the new room becomes available. As such, significant design advice (may be particularly important in the case of the more complex cleanroom areas) can be obtained from these existing lab's. The Design Consultant is responsible for collecting and collating previous design information, as well as additional Client requirements. It is expected that the design consultant will visit the existing facility in Canberra to extract existing information.

This group of 'Uranium Series Labs' is currently being funded separately to the previously defined CAS building requirements, that is being supplemented by the EIF project.

General Facility Requirements

Several heavy pieces of equipment & magnets are required throughout the laboratories, which will drive many design aspects. These equipment items will be installed in a staged process after facility construction. Ongoing access to the room (via removable windows/roof, or some other entry method) for these large, heavy pieces of equipment is critical.

Airflow through the facility is also critical, and should be considered early in the design. Supply and exhaust air grills should be located such as to best maintain air flow from the most clean side of a room to the most dirty side of the room. Flow between rooms is also to be from clean to dirty.

Due to the chemistry undertaken, one of the cleanrooms is to be completely metal free (including fume cupboards, shelving, internal windows etc). The client has experience with this type of cleanroom and is available for advice.

A liquid Nitrogen tank is required for the facility, to supply Nitrogen gas via liquid Nitrogen boil-off.

A functional relationship of the required rooms is shown in Figure 1. This is compiled using room relationships and commonalities in room requirements and not to be taken as design direction. Other grouping arrangements should be considered on their merit.

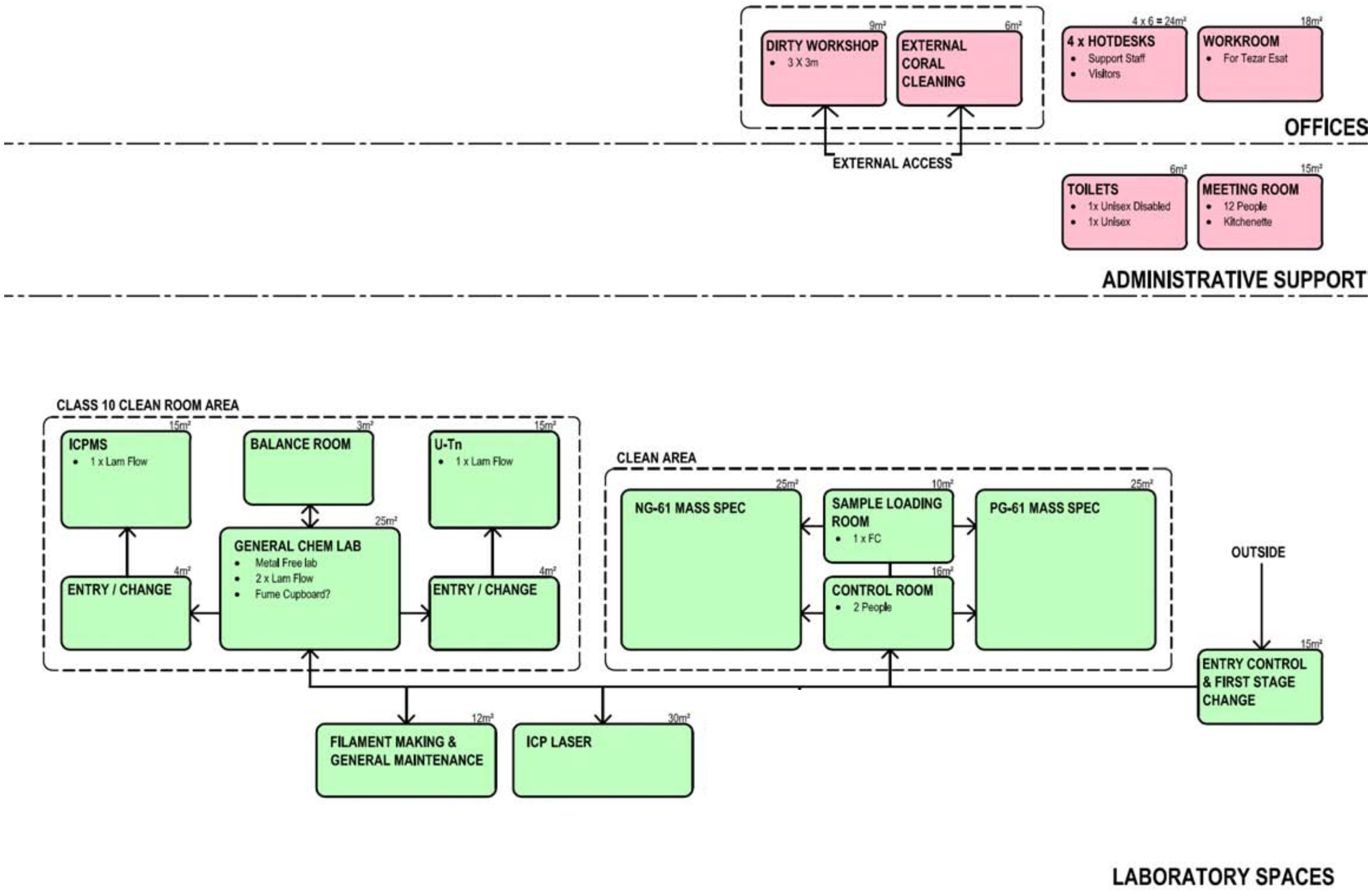


Figure 2: Functional Relationship Diagram

Room Details

Detailed room descriptions and details are included below. These are in addition to the Cleanroom grades shown in Figure 1.

Filament Making & Maintenance Room

To contain a Fume Cupboard, as well as 20 degree chilled water, Nitrogen gas and Compressed Air supply.

NG-61 & PG-61 Mass Spectrometry Rooms

The NG-61 and PG-61 are both Thermal Isotope Mass Spectrometers (TIMS). A mass spectrometer is used to determine isotope ratios of a sample, from which valuable information about the sample can be determined.

These rooms are controlled by a communal control room. This control room should have visual access to both these rooms. Each magnet weighs about 12 tons and requires solid foundations for vibration free support. The rooms should have access for a heavy duty forklift to lift the magnet as required. This could be via a removable wall or window. Controls & services for the machine should be via ducting in the floor.

Temperature control in these rooms is critical for the sensitive equipment housed here. Separate air conditioning system to the remaining facility should be considered. Close to the electromagnet for each spectrometer, temperature control should ideally be 23 +/- 0.1 ºC. Supply air for the room should be kept below 20ºC. The Design Consultant should visit the existing facility at ANU to view the existing system.

Require Nitrogen gas, compressed air and 20 degree chilled water. Water supply to this room should be regulated to +/- 0.2 degrees.

ICP Laser Room

This room will house a Inductively Coupled Plasma Laser Ablation (ICP laser) system to be purchased within the next 5 years. The room is to provide a supply of N gas from an outside liquid N tank, compressed air & chilled 20 degree water for cooling the device.

U-Th Lab

This lab is for Uranium Series dating (age dating, largely of coral samples). Uranium concentrations are compared to Thorium concentrations to determine age of the sample.

The process is extremely susceptible to minute amounts of rust (from metals exposed to an acidic environment), as so is to be a metal free lab as much as possible. This should include wooden (or other) door frames, hinges to be considered could be either plastic or epoxy coated metal. Metal screws can be used where essential, but must be sealed well or covered in a plastic cup. 200mm high vinyl coves are required through the lab. Cupboards under the fume cupboard are to house acids & solvents, and need to be aired and will require plastic trays to contain spills.

A central island bench is preferred by the Client to suit the work flow carried out here. The Design Consultant is to confirm these requirements with the Client.

This lab should have a cleanroom graded changeroom equal to the grade of the room.

ICP Mass Spectrometer (ICPMS) Lab

This room will house an Inductively Coupled Plasma Mass Spectrometry system. This is another type of mass spectrometry that uses a laser to remove ions from the surface of a sample.

The process is also extremely susceptible to minute amounts of rust (from metals exposed to an acidic environment), as so is to be a metal free lab as much as possible. This should include wooden (or other) door frames, hinges to be considered could be either plastic or epoxy coated metal. Metal screws can be used where essential, but must be sealed well or covered in a plastic cup. 200mm high vinyl coves are required through the lab. Cupboards under the fume cupboard are to house acids & solvents, and need to be aired and will require plastic trays to contain spills.

The room is to provide a supply of N gas from an outside liquid N tank, compressed air & chilled 20 degree water for cooling the device.

This lab should have a cleanroom graded changeroom equal to the grade of the room.

General Chemistry Lab

This room will be a preparation room for U-Th and ICPMS lab's.

As it is a preparation room for the two metal free labs, it is also to be metal free as much as possible. This should include wooden (or other) door frames, hinges to be considered could be either plastic or epoxy coated metal. Metal screws can be used where essential, but must be sealed well or covered in a plastic cup. 200mm high vinyl coves are required through the lab. Cupboards under the fume cupboard are to house acids & solvents, and need to be aired and will require plastic trays to contain spills.

Entry Control & First Stage Change

This is a first stage entry to the facility, where users will put on overshoes and wash hands prior to entering the facility. This is not a cleanroom graded area.

Balance Room

This will house a balance & measuring equipment for the labs.

Sample Loading Room

The sample loading room is for loading of PG-61 and NG-61 samples. This is envisaged to be via underfloor pipes, although alternatives should be considered.

Control Room

The control room should look onto both NG-61 and PG-61 machines. Conduits are needed (likely to be through pipes in the floor) between this room and the 2 machines. As both machines could be operated simultaneously, it should be large enough to fit 2 separate operators.

Filament Making & General Maintenance Room

This is for general equipment maintenance, and requires 20ºC water, Nitrogen and Compressed air supply. It also requires a spot welder. The spot welder power supply should be seperated from the NG-61 & PG-61 power supply, as the welder affects the stability of the machine performance. Options for this separation should be given in the Concept Electrical Design.

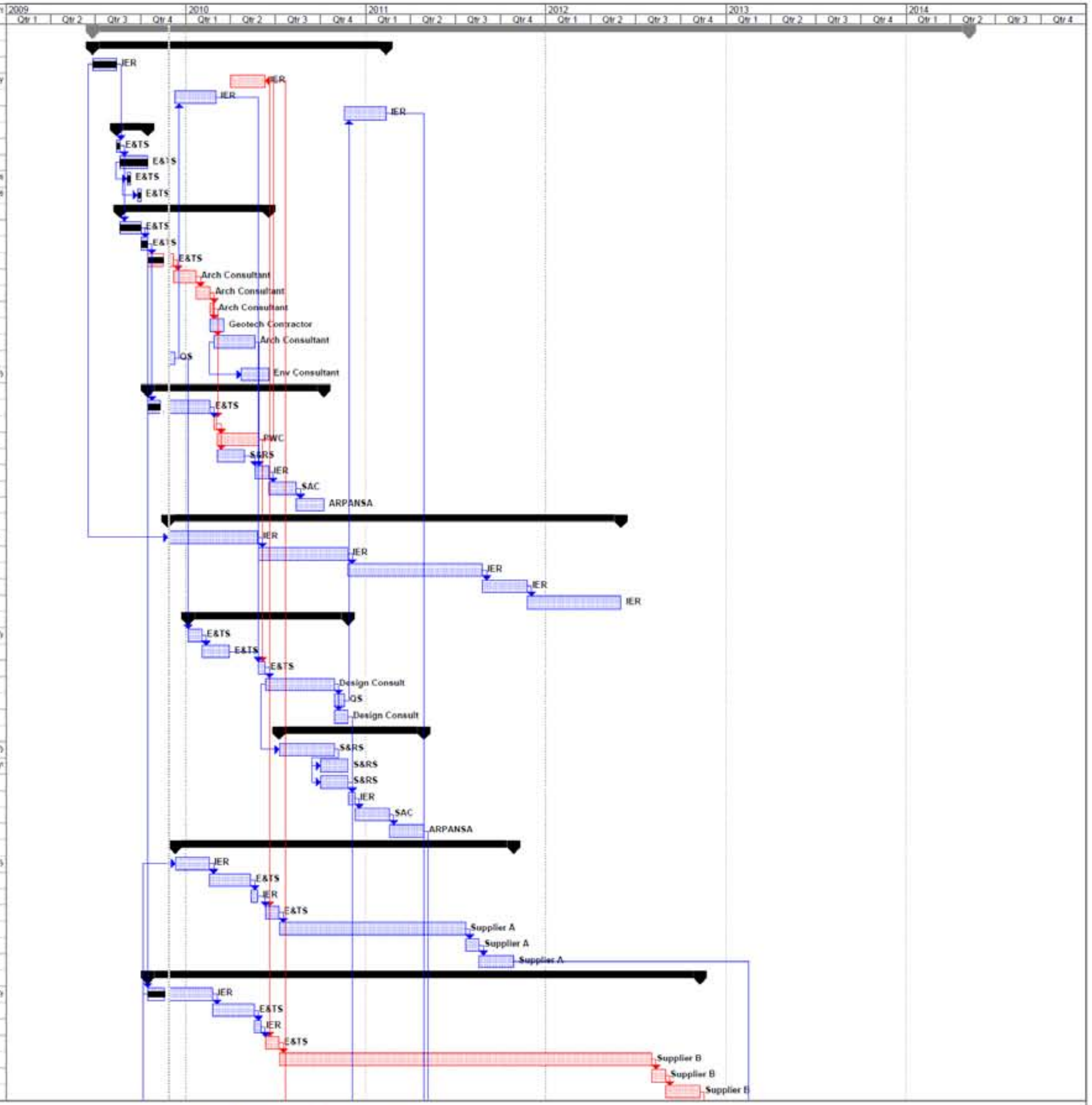
APPENDIX G - Applicable Codes and Standards

AS A185 Solvent-welding cement for use with Rigid PVC Pipes and Fittings
AS 1023 Low Voltage Switchgear and Control Gear
AS 1029 Low Voltage Contractor
AS 1055 Acoustics - Description and measurement of Environment Noise
AS 1074 Medium and Heavy Steel Tube
AS 1099 Tests for Electronic Equipment
AS 1100 Technical Drawings
AS 1101 Graphical Symbols for General Engineering
AS 1102 Graphical Symbols for Electrotechnology
AS 1104 Informative Symbols for use on Electrical and Electronic Equipment
AS 1167 Allow Filler Rods for Brazing
AS 1172 Vitreous China Water Closet Pans
AS 1192 Electroplated Coatings of Nickel and chromium
AS 1202 A.C. Motor Starters
AS 1210 Unfired pressure levels
AS 1218 Flushing cisterns
AS 1221 Fire Hose Reels
AS 1260 Unplasticised PVC (UPVC) pipes and fittings for sewerage application
AS 1324 Air filters for use in air conditioning and general ventilation
AS 1342 Precast Reinforced Concrete Drainage Pipes
AS 1345 Rules for Identification of piping, conduits and ducts
AS 1371 Toilet Seats of Moulded Plastic
AS 1397 Steel sheet and strip - Hot dipped zinc coated or aluminium/zinc coated
AS 1415 Unplasticised PVC (UPVC) pipes and fittings for soil, waste and vent (SWV) applications
AS 1432 Copper Tubes for Water, Gas and Sanitation
AS 1464 UPVC pipes and fittings for gas reticulation
AS 1470 Health and safety at work - Principles and practice
AS 1477 & ASK138 UPVC pressure pipes with solvent cement joints
AS 1530 Part 3: Tests for early fire hazard properties
AS 1571 Seamless copper tubes for use in refrigeration
AS 1572 Seamless copper and copper alloy tubes for General Engineering purposes
AS 1585 Capillary and Brazing Fittings for Copper and Copper Alloy
AS 1588 Filler Rods for Welding
AS 1589 Copper and Copper Based Alloy Fittings for use in Sanitary Plumbing Installations
AS 1596 LP Gas Storage and Handling
AS 1628 Copper Alloy Gate Valves and Non Return Valves for use in Water Supply and Hot Water Supply
AS 1646 Rubber Joint Rings for Water Supply, Sewerage and Drainage Purposes
AS 1668 SAA Mechanical Ventilation and air conditioning code:
Part 1: Fire and smoke control
Part 2: Mechanical ventilation for acceptable indoor-air quality
AS 1684 Timber Framing Code
AS 1670 Automatic fire detection and alarm systems
AS 1677 SAA Refrigeration Code
AS 1720 Timber Structures
AS 1730 Wash Basins
AS 1756 Household Sinks
AS 1768 Lightning Protection
AS 2005 Low Voltage Fuses
AS 2032 Code of Practice for Installation of UPVC Pipe Systems
AS 2052 Metallic Conduits and fittings
AS 2053 Non-Metallic Conduits and Fittings

AS 2067 Switchgear Assemblies and ancillary equipment
AS 2129 Flanges for pipes, valves, and fittings
AS 2129 Flanges for Pipes, Valves and Fittings
AS 2201 Intruder Alarm Systems (parts 1, 2 and 3)
AS 2279 Disturbances in Mains Supply Networks
AS 2373 Control cables for electricity supply systems
AS 2417 1980 Parts 1,2 and 3 - The International Acceptance Test Codes
AS 2419 Fire hydrants
AS 2441 Installation of Fire Hose Reels
AS 2528 Bolts, studbolts and nuts for flanges
AS 2546 Printed Circuit Boards
AS 2566 Plastic pipe laying design
AS 2613 Safety Devices for Gas Cylinders
AS 2638 Cast Iron sluice valves for waterwork purposes
AS 2758 Aggregates and rocks for engineering purposes - Part 1 Concrete Aggregates.
AS 3000 SAA Wiring Rules
AS 3008 Electrical Installations - Selection of cables
AS 3080 Integrated Telecommunications cabling systems for commercial buildings
AS 3084 Telecommunications pathways and spaces for commercial buildings
AS 3086 Integrated Telecommunications cabling systems for small office/home office premises
AS 3013 Electrical Installations - Wiring systems for specific applications
AS 3147 Approval and test specification - Electric cables
AS 3500 National Plumbing and Drainage Code - Suite of standards 1 to 4
AS 3600 Concrete structures
AS 3610 Formwork for concrete
AS 3666 Microbial control - Air handling and water systems of buildings
AS 3700 SAA Masonry Code
AS 3901 Quality Assurance Standards
AS 3905.2 Quality Systems Guidelines
AS 4041 Pressure Piping
AS 4100 Steel structures
AS 4254 Ductwork for air-handling systems in buildings
AS 4600 Cold-formed steel structures
SMACNA Low pressure duct construction standards
AS CA33 Code of practice for concrete pipe laying design
AG 601-1787 - Installation Code for Gas Burning Appliances and Equipment
AS HB3 Drawing Standards
AS HB-27 Hand Book for Field Testing of Balanced Cable Installations
SAA/SNZ MP77 - A Definition of Year 2000 Conformity Requirements
Building Code of Australia.
Local supply authority regulation
AUST ROADS Design Codes
Water Services Association of Australia - Sewage and Water Codes.

APPENDIX H- Project Schedule

ID	Indicators	Task Name	Duration	Start	Finish	Predecessors
0		**CAS Project schedule 100909**	**1221.5 days**	**Fri 26/06/09**	**Fri 9/05/14**	
1		**Project Establishment / CIC's**	**406.5 days**	**Fri 26/06/09**	**Fri 11/02/11**	
2	✓	CIC prep & approval - planning and prelim design	35 days	Fri 26/06/09	Thu 13/08/09	
3		CIC prep & approval - accelerator & beam supply	50 days	Fri 2/04/10	Fri 11/06/10	25FF+10 day
4		CIC prep & approval - facility design	50 days	Thu 10/12/09	Tue 2/03/10	20
5		CIC prep & approval - facility Construction	50 days	Fri 19/11/10	Fri 11/02/11	41
6	✓	**Project Initiation Stage**	**45 days**	**Fri 14/08/09**	**Thu 15/10/09**	
7	✓	Develop Governance Structures	5 days	Fri 14/08/09	Thu 20/08/09	2
8	✓	Prepare Project Management Planning	40 days	Fri 21/08/09	Thu 15/10/09	7
9	✓	Prepare schedule estimate	5 days	Fri 4/09/09	Thu 10/09/09	8SS+10 days
10	✓	Prepare budget estimate	5 days	Fri 25/09/09	Thu 1/10/09	9SS+15 days
11		**Preliminary Design & Development**	**206.5 days**	**Fri 21/08/09**	**Fri 18/06/10**	
12	✓	Review client functional requirements	30 days	Fri 21/08/09	Thu 1/10/09	7
13	✓	Develop consultancy brief	10 days	Fri 2/10/09	Thu 15/10/09	12
14		Price & Engage design consultant	30 days	Fri 16/10/09	Mon 7/12/09	13
15		User requirements definition	25 days	Mon 7/12/09	Fri 22/01/10	14
16		Concept development options	20 days	Fri 22/01/10	Fri 19/02/10	15
17		Concept cost estimates for review	5 days	Fri 19/02/10	Fri 26/02/10	16
18		Geotechnical Investigations	20 days	Fri 19/02/10	Fri 19/03/10	16
19		Preliminary Design	60 days	Fri 26/02/10	Fri 21/05/10	17
20		Quantity surveyor cost plan & budget prep	10 days	Thu 26/11/09	Wed 9/12/09	
21		Environmental Assessment	40 days	Fri 23/04/10	Fri 18/06/10	19SS+40 day
22		**Project Licensing A**	**246.5 days**	**Fri 16/10/09**	**Fri 8/10/10**	
23		PWC Report Preperation	70 days	Fri 16/10/09	Fri 19/02/10	13
24		PWC Submission	5 days	Fri 26/02/10	Fri 5/03/10	23,17
25		PWC review and approval	60 days	Fri 5/03/10	Fri 28/05/10	24
26		Site Preperation Documents Prep	40 days	Fri 5/03/10	Fri 30/04/10	24
27		ARPANSA Site Preparation Licence Application	20 days	Fri 21/05/10	Fri 18/06/10	19,26
28		SAC Review & Assessment	40 days	Fri 18/06/10	Fri 13/08/10	27
29		ARPANSA review and approval	40 days	Fri 13/08/10	Fri 8/10/10	28
30		**GAS Filled Magnet Project Scope**	**628 days**	**Thu 26/11/09**	**Fri 1/06/12**	
31		Phase 1 - Planning & initial GFM+beam-line modelling	122 days	Thu 26/11/09	Thu 27/05/10	2SS+3 days
32		Phase 2 - Detailed Specification & Quotations	130 days	Fri 28/05/10	Thu 25/11/10	31
33		Phase 3 - GFM Delivery & Beamline purchase	186 days	Fri 26/11/10	Thu 25/08/11	32
34		Phase 4 - Beamline constructed & assemble GFM	65 days	Fri 26/08/11	Thu 24/11/11	33
35		Phase 5 - testing & commissioning	126 days	Fri 25/11/11	Fri 1/06/12	34
36		**Detailed Design of Facilities**	**232.5 days**	**Wed 6/01/10**	**Fri 26/11/10**	
37		Develop consultancy brief	20 days	Wed 6/01/10	Tue 2/02/10	20FS+10 day
38		Tender Detailed design package	40 days	Wed 3/02/10	Tue 30/03/10	37
39		Engage design consultant	10 days	Fri 28/05/10	Fri 11/06/10	38,25,4
40		Detailed Design Development	100 days	Fri 11/06/10	Fri 29/10/10	39
41		Quantity surveyor cost plan & budget prep	15 days	Fri 29/10/10	Fri 19/11/10	40
42		Design Docuemntation for tender	20 days	Fri 29/10/10	Fri 26/11/10	40
43		**Project Licensing B**	**200 days**	**Fri 9/07/10**	**Fri 29/04/11**	
44		PSAR	80 days	Fri 9/07/10	Fri 29/10/10	40SS+20 day
45		Safety Assessment	40 days	Fri 1/10/10	Fri 26/11/10	44FS-20 day
46		Construction licence document suite	40 days	Fri 1/10/10	Fri 26/11/10	45SS
47		ARPANSA Construction licence Application	10 days	Fri 26/11/10	Fri 10/12/10	46
48		SAC Review & Assessment	40 days	Fri 10/12/10	Fri 18/02/11	47
49		ARPANSA review and approval	50 days	Fri 18/02/11	Fri 29/04/11	48
50		**Procurement 1MV Compact**	**471.5 days**	**Fri 11/12/09**	**Fri 28/10/11**	
51		Define Requirements & Prepare Brief	40 days	Fri 11/12/09	Wed 17/02/10	59SS+40 day
52		Tender for Preferred Supplier	60 days	Thu 18/02/10	Wed 12/05/10	51
53		Finalise design & scope with preferred supplier	10 days	Thu 13/05/10	Wed 26/05/10	52
54		Finalise & Issue Contract	20 days	Fri 11/06/10	Fri 9/07/10	53,3
55		Fabrication	260 days	Fri 9/07/10	Fri 22/07/11	54
56		FAT	20 days	Fri 22/07/11	Fri 19/08/11	55
57		Shipping / Delivery	50 days	Fri 19/08/11	Fri 28/10/11	56
58		**Procurement 5MV Tandem**	**771.5 days**	**Fri 16/10/09**	**Fri 9/11/12**	
59		Define Requirements & Prepare Brief	80 days	Fri 16/10/09	Wed 24/02/10	12FS+10 day
60		Tender for Preferred Supplier	60 days	Thu 25/02/10	Wed 19/05/10	59
61		Finalise design & scope with preferred supplier	10 days	Thu 20/05/10	Wed 2/06/10	60
62		Finalise & Issue Contract	20 days	Fri 11/06/10	Fri 9/07/10	61,3
63		Fabrication	520 days	Fri 9/07/10	Fri 3/08/12	62
64		FAT	20 days	Fri 3/08/12	Fri 31/08/12	63
65		Shipping / Delivery	50 days	Fri 31/08/12	Fri 9/11/12	64



Project: CAS Project schedule 100909
Date: Fri 27/11/09

Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

Page 1

ID		Task Name	Duration	Start	Finish	Predecessors
66		**Procurement Microprobe**	**531 days**	**Fri 30/10/09**	**Thu 8/12/11**	
67		Define Requirements & Prepare Brief	60 days	Fri 30/10/09	Thu 4/02/10	59SS+10 day
68		Tender for Supply	60 days	Fri 5/02/10	Thu 29/04/10	67
69		Finalise design & scope with preferred supplier	60 days	Fri 30/04/10	Thu 22/07/10	68
70		Finalise & Issue Contract	20 days	Fri 23/07/10	Thu 19/08/10	69,3
71		Fabrication	260 days	Fri 20/08/10	Thu 1/09/11	70
72		FAT	20 days	Fri 2/09/11	Thu 29/09/11	71
73		Shipping / Delivery	50 days	Fri 30/09/11	Thu 8/12/11	72
74		**Procurement Facility**	**120 days**	**Fri 26/11/10**	**Fri 27/05/11**	
75		Prepare Construction Brief & Tender	20 days	Fri 26/11/10	Fri 7/01/11	42
76		Tender for Works	60 days	Fri 7/01/11	Fri 1/04/11	75
77		Finalise & Issue Contract	20 days	Fri 29/04/11	Fri 27/05/11	76,49,5
78		**Facility Construction**	**320 days**	**Fri 27/05/11**	**Fri 31/08/12**	
79		Site Mobilisation	10 days	Fri 27/05/11	Fri 10/06/11	77
80		Site Preperation	10 days	Fri 10/06/11	Fri 24/06/11	79
81		Bulk Earthworks	20 days	Fri 24/06/11	Fri 22/07/11	80
82		Pier Foundations	10 days	Fri 22/07/11	Fri 5/08/11	81
83		Detailed Excavations	10 days	Fri 5/08/11	Fri 19/08/11	82
84		In ground Services	10 days	Fri 19/08/11	Fri 2/09/11	83
85		Slab Construction	20 days	Fri 2/09/11	Fri 30/09/11	84
86		Concrete Walls	15 days	Fri 30/09/11	Fri 21/10/11	85
87		Structural steel Installation	15 days	Fri 21/10/11	Fri 11/11/11	86
88		Roof installations	10 days	Fri 11/11/11	Fri 25/11/11	87
89		Cladding & Glazing	10 days	Fri 25/11/11	Fri 9/12/11	88
90		Mechanical services	60 days	Fri 3/02/12	Fri 27/04/12	94SS+10 day
91		Accelerator Services	60 days	Fri 3/02/12	Fri 27/04/12	90SS
92		Electrical Services	60 days	Fri 9/12/11	Fri 16/03/12	89
93		Hydraulic Services	30 days	Fri 23/12/11	Fri 17/02/12	92SS+10 day
94		Gas services	40 days	Fri 20/01/12	Fri 16/03/12	93SS+10 day
95		Ceilings	10 days	Fri 9/12/11	Fri 23/12/11	89
96		Partitions	10 days	Fri 23/12/11	Fri 20/01/12	95
97		Linings	10 days	Fri 20/01/12	Fri 3/02/12	96
98		Paint	10 days	Fri 3/02/12	Fri 17/02/12	97
99		Floor Finishes	10 days	Fri 17/02/12	Fri 2/03/12	98
100		Joinery / FFE	40 days	Fri 2/03/12	Fri 27/04/12	99
101		Services Fitout	30 days	Fri 27/04/12	Fri 8/06/12	100,90,92,93
102		Punchlisting & Defect Rectification	30 days	Fri 8/06/12	Fri 20/07/12	101
103		Services Commissioning	40 days	Fri 8/06/12	Fri 3/08/12	101
104		Close out Issues & final defects	20 days	Fri 3/08/12	Fri 31/08/12	102,103
105		ANSTO IT Installations	40 days	Fri 6/07/12	Fri 31/08/12	103SS+20 d
106		Practical Completion	0 days	Fri 31/08/12	Fri 31/08/12	104
107		**Equipment Installation**	**150 days**	**Fri 31/08/12**	**Fri 12/04/13**	
108		IMV Compact Installation c/w beamlines	40 days	Fri 15/02/13	Fri 12/04/13	109,57
109		5MV Tandem Installation c/w beamlines	60 days	Fri 9/11/12	Fri 15/02/13	106,65
110		Microprobe Installations	20 days	Fri 15/02/13	Fri 15/03/13	109,73
111		Control Room works	100 days	Fri 31/08/12	Fri 1/02/13	105,106
112		Ancillary / ANSTO Equipment installations	100 days	Fri 31/08/12	Fri 1/02/13	106
113		**Commissioning / Acceptance Testing**	**120 days**	**Fri 12/04/13**	**Fri 27/09/13**	
114		1MV Compact Accelerator	60 days	Fri 12/04/13	Fri 5/07/13	108
115		5MV Tandem Accelerator	60 days	Fri 5/07/13	Fri 27/09/13	114
116		Microprobe	30 days	Fri 19/07/13	Fri 30/08/13	115SS+10 d
117		**Project Finalisation**	**290 days**	**Fri 31/08/12**	**Fri 25/10/13**	
118		Facility Documentation	10 days	Fri 31/08/12	Fri 14/09/12	106
119		Accelerator Documentation	10 days	Fri 27/09/13	Fri 11/10/13	115,116
120		Overall CAS project	10 days	Fri 11/10/13	Fri 25/10/13	119,118
121		**Project Licensing C**	**440 days**	**Fri 3/08/12**	**Fri 9/05/14**	
122		FSAR	100 days	Fri 3/08/12	Fri 21/12/12	103
123		Safety Assessment	60 days	Fri 21/12/12	Fri 29/03/13	122
124		Operating licence document suite	40 days	Fri 29/03/13	Fri 24/05/13	123
125		Finalisation of Commissioning results	20 days	Fri 27/09/13	Fri 25/10/13	115,106
126		ARPANSA Operating licence Application	20 days	Fri 25/10/13	Fri 22/11/13	124,123,125
127		SAC Review & Assessment	50 days	Fri 22/11/13	Fri 14/02/14	126
128		ARPANSA review and approval	60 days	Fri 14/02/14	Fri 9/05/14	127
129		CAS PROJECT SCOPE COMPLETE	0 days	Fri 27/09/13	Fri 27/09/13	116,115
130		FACILITY FULLY LICENSED	0 days	Fri 9/05/14	Fri 9/05/14	128

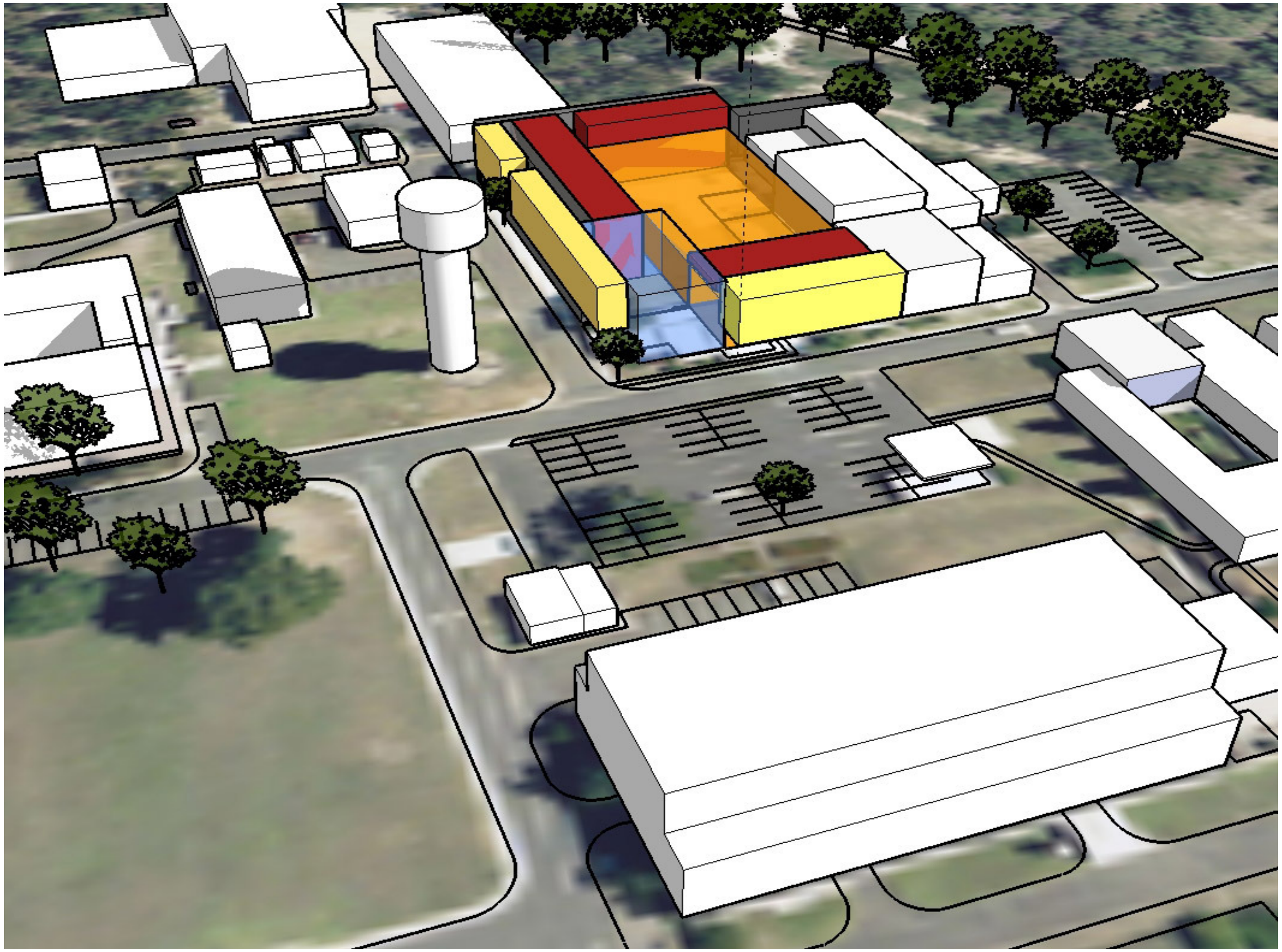
Project: CAS Project schedule 100909
Date: Fri 27/11/09

Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

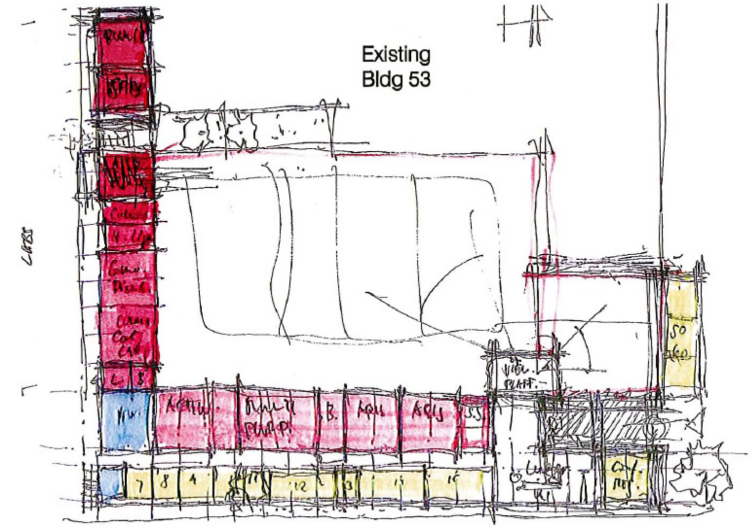
Page 2

APPENDIX I- Conceptual Designs

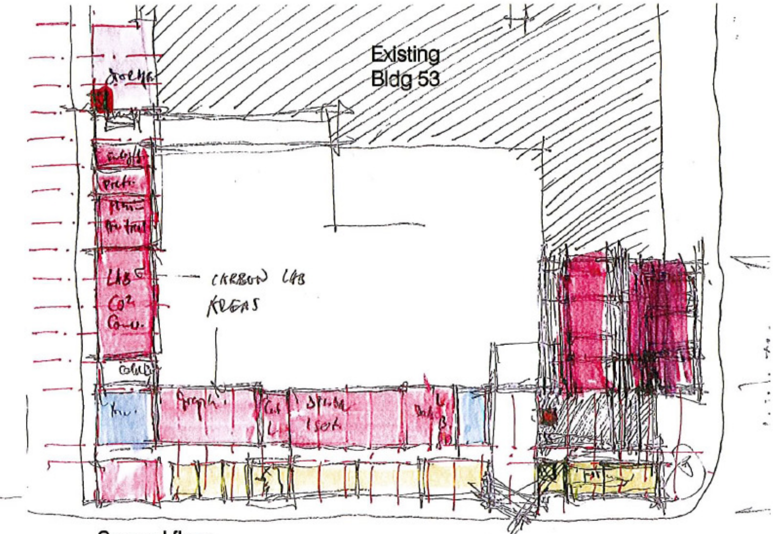
Option 1: Facility located to be part of B53 (ANTARES Building)



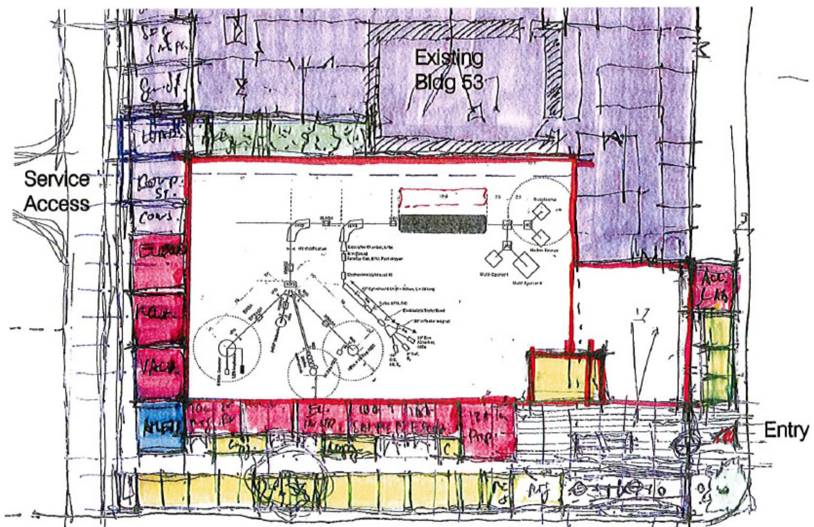
JACKSON ARCHITECTURE
DARYL JACKSON ROBIN DYKE
Archite



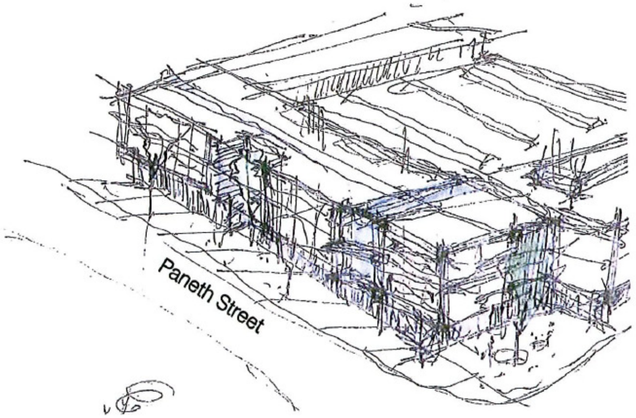
First floor



Second floor



Ground floor



Perspective sketch

ANSTO - CAS - Site 0 - First plan studies

20/01/2010

Option 2: Facility located in vacant block north of the IER administration building

Option 3: Facility located on existing car park are between B53 (ANTARES) and B22 (STAR)