WHEN LESS IS MORE – CONSTRUCTION OF THE AUSTRALIAN SYNCHROTRON

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Abstract

The Australian Synchrotron is a 3 GeV facility under construction next to Monash University in Melbourne. The project was launched in January 2003 and is scheduled for completion in March 2007. The funding of Aus$206M (~120 MEuros) covers all costs associated with the site, building, accelerators, staffing and the first nine beamlines. The building contract was placed in July 2003 and completed in February 2005. Installation of the accelerators began in April 2005 and was complete by May 2006. Commissioning of the injection system began in October 2005, and storage ring commissioning began June 2006, with beamline commissioning beginning January 2007 and facility handover scheduled for March 2007. The project is being delivered with a staff of ~50, which has meant that much of the detailed design work and project management for major systems (e.g., the injection system, RF system, support girders, vacuum vessels and front ends) has been performed by commercial suppliers under turn-key contracts.

FACILITY OVERVIEW

Figure 1: The Australian Synchrotron.

The Australian Synchrotron is a medium-energy third generation synchrotron facility being built next to Monash University in Melbourne, and is being delivered by Major Projects Victoria (MPV), a part of the Victorian State Government. The main design parameters of the machine are listed in Table 1. The funding for the construction of the facility totals ~Aus$206M (~120 MEuros), of which $157M is for the building and accelerators, and $49M for the first phase of nine beamlines. The funding for the building and accelerators has been provided by the Victorian State Government, whilst the beamlines are being funded by a group of interested parties, including universities, research organisations and other state governments.

Further details of the accelerator design can be found in references [1,2].

Table 1: Key design parameters

Energy	3 GeV
Beam current	200 mA
Circumference	216 m
Number of straights	14
RF frequency	500 MHz
Beam size (in bending magnets) (σ)	87 μm x 58 μm
Natural Emittence (η = 0.24 m) (σ)	7 nm
Injection Energy	3 GeV

STAFFING

The Australian synchrotron is being delivered with a relatively small staff of only 54 people, plus specialist contractors and consultants. The organisational structure of the project delivery team is shown in Figure 2.

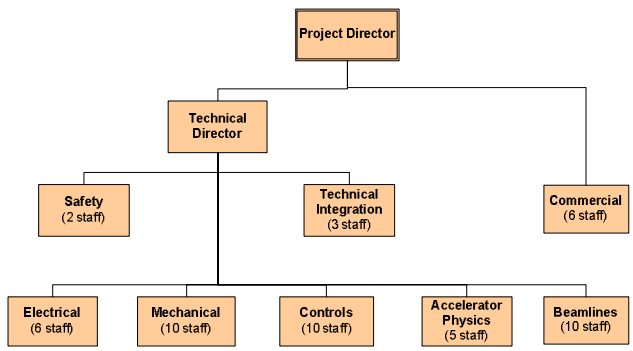

Figure 2: Organisation structure.

Due to the relatively small number of staff, much of the responsibility for the design and project management has been placed on suppliers, with turn-key contracts. Contracts for the following systems included all design, engineering, project management, installation and commissioning:

- Injection system (including linac and booster)
- Storage ring RF system
- Storage ring vacuum vessels
- Beamline photon delivery systems
- Storage ring girders
- Front ends

Contracting turn-key systems has meant great attention needs to be paid to the quality of documentation and training, to ensure that our staff have the capability to maintain the facility to give the required level of performance for reliability and availability.

SCHEDULE

Table 2 shows the main schedule milestones for the project. The project is currently on schedule for completion and handover to the operator in March 2007. Since the original baseline project schedule was prepared in January 2003 the major schedule milestones have been achieved within days of the target dates, including the start of accelerator installation in April 2005, the completion of installation in May 2006 and first turns in the storage ring in June 2006.

Table 2: Schedule Milestones.

Design announced. Technical Director in place.	January 2003
Building contract placed	July 2003
Building complete	February 2005
Staff move into building	March 2005
Installation begins	April 2005
Injection system commissioning begins	October 2005
Storage ring installation complete	May 2006
Storage ring commissioning begins	June 2006
First turns in the storage ring	June 2006
Beamline installation begins	September 2006
Beamline commissioning begins	January 2007
Handover to the operator	March 2007

Figure 3 shows the final storage ring dipole being installed on schedule in March 2006, and Figure 4 shows the completed 100 MeV linac.

Figure 3: A fish-eye view of the installation of the final storage ring dipole magnet.

BEAMLINES

Table 3 lists the first phase of nine beamlines for the Australian Synchrotron. The first phase of beamlines is expected to service a broad range of the needs of Australian scientists, covering the x-ray energy range from 100 eV to 65 keV. It is hoped that the facility will be servicing >1,200 scientists per year from 2010. Six of the first phase beamlines are on insertion devices

Table 3: The first phase beamlines.

Beamline Identifier	Technique	Source
2IR	Infrared Spectroscopy	Bending Magnet
3BM	Protein Crystallography	Bending Magnet
3ID	Protein Crystallography	In-vacuum Undulator
8ID	Imaging & Medical Therapy	Superconducting Wiggler
9ID	Microspectroscopy	In-vacuum Undulator
10BM	Powder Diffraction	Bending Magnet
12ID	X-ray Absorption Spectroscopy	Wiggler
13ID	Small & Wide Angle X-ray Scattering	In-vacuum Undulator
14ID	Soft X-ray Spectroscopy	APPLE II Undulator

Figure 4: The 100 MeV linac.

MAJOR MILESTONES ACHIEVED

At the time of writing (June 2006), besides the completion of all the conventional facilities and the installation of all the accelerator systems, the following commissioning milestones have been reached:

- The machine vacuum system is complete, with the storage ring at 5×10^{-10} mbar.
- The injection system is close to sign-off, and has been used to inject 3 GeV electrons into the storage ring.
- Each of the four RF cavity systems has been operated individually at close to its maximum power rating.
- First turns around the storage ring have been achieved (as shown in Figure 5).

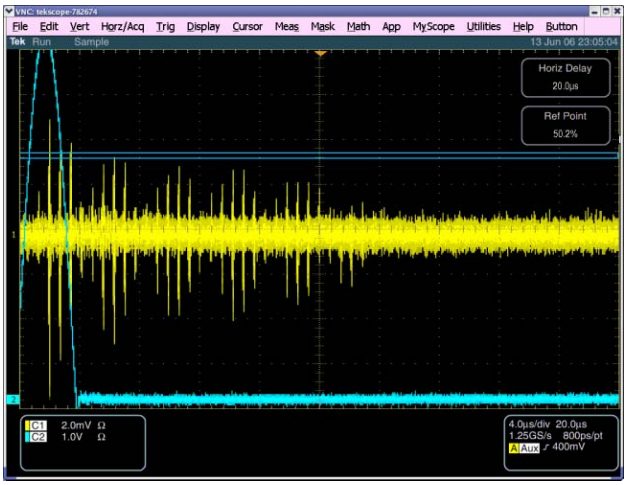

Figure 5: A trace showing the first ~30 turns in the storage ring.

REMAINING CHALLENGES

Although great progress has been made so far, there are still many other major milestones to be achieved in the remaining months before handover, including:

- Optimisation of the injection system to increase current and reduce beam losses.
- Final commissioning of the RF system, to allow all four cavities to operate simultaneously at maximum power.
- Storing of the electron beam, and accumulation to meet the required handover criteria for lifetime and current.
- Installation and commissioning of the initial beamlines, including radiation hutches.

A plan drawing of the facility is shown in Figure 6.

ACKNOWLEDGEMENTS

Besides the huge input from our in-house staff, the progress that has been made would not have been possible without the efforts of our suppliers, contractors and specialist consultants, who are too numerous to mention individually.

REFERENCES

[1] G. LeBlanc, M. Boland and E. Tan, "The Australian Synchrotron Storage Ring", proceedings of EPAC'04.

[2] A. Jackson, "The Australian Synchrotron Project – Update", proceedings of PAC'05.

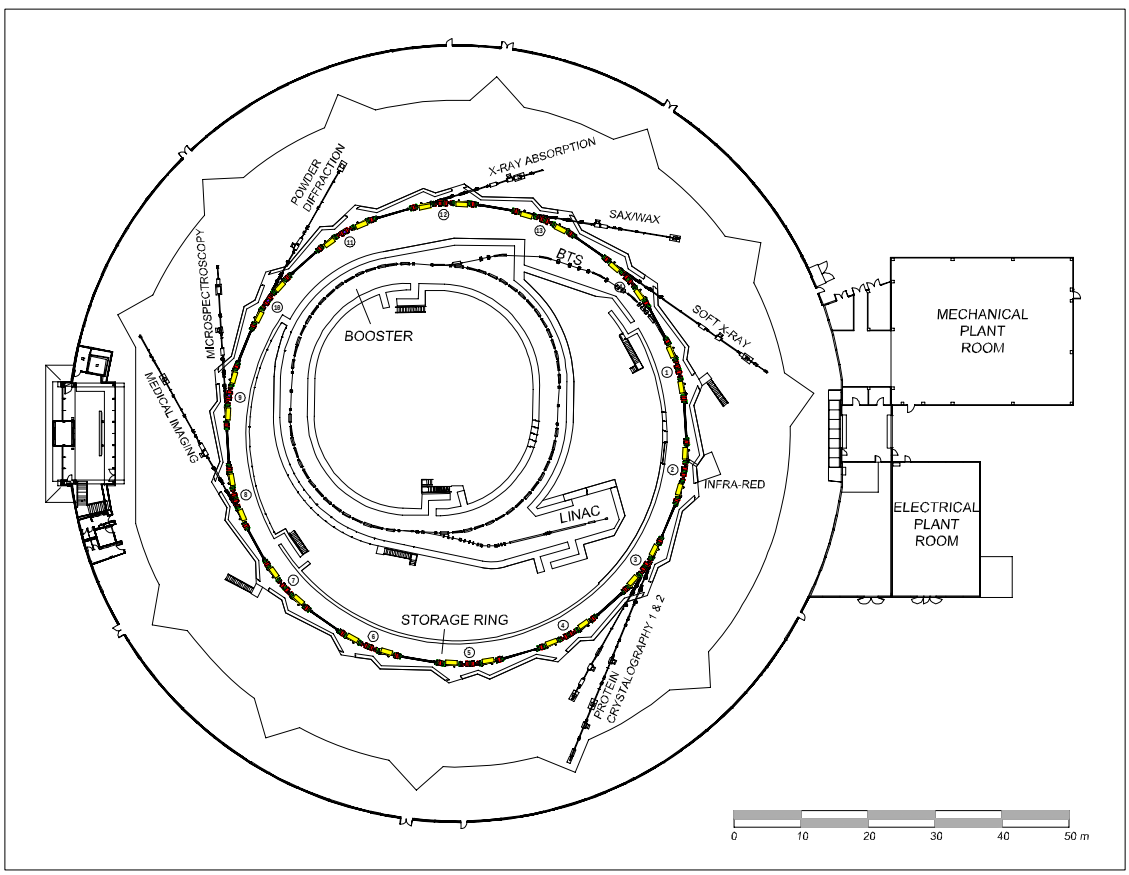

Figure 6: Layout of the Australian Synchrotron