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Ecolibrium



MOD.

"THUS IN
WONDER
I AM LOST"

David Unaipon

Lofty goals

An SA cancer facility boasts world-class holistic design.



AIRAH



FEATURE

When equipment is exposed it can be vulnerable to extreme weather events.



parts should allow the equipment to continue running at some capacity, even if reduced, for a certain period until disruption has passed and trained service professionals can attend to assess the system in its entirety.

Documentation should provide step-by-step instructions on how to check and replace components. Training for semi-professional staff must be available, providing guidance on what to look and listen out for. These staff members should have a general understanding of what is happening within the equipment so they know what to stay away from, whether their repairs will make any difference, to inform service personnel what parts to bring, but most importantly to eliminate potential injury.

A PIVOTAL ROLE FOR RESILIENCE

The increasing frequency of acute shocks and chronic stresses associated with climate change, coupled with other potential socio-political disruptions means resilience will play a pivotal role in the future of our cities, buildings and services. Exploiting the wealth of knowledge from those service professionals who will inevitably be at the coalface when the time comes ensures our buildings will be more robust during disruption, and more quickly bounce back to “business as usual”. ■



*Optimal building
control solutions for
optimum building
performance*

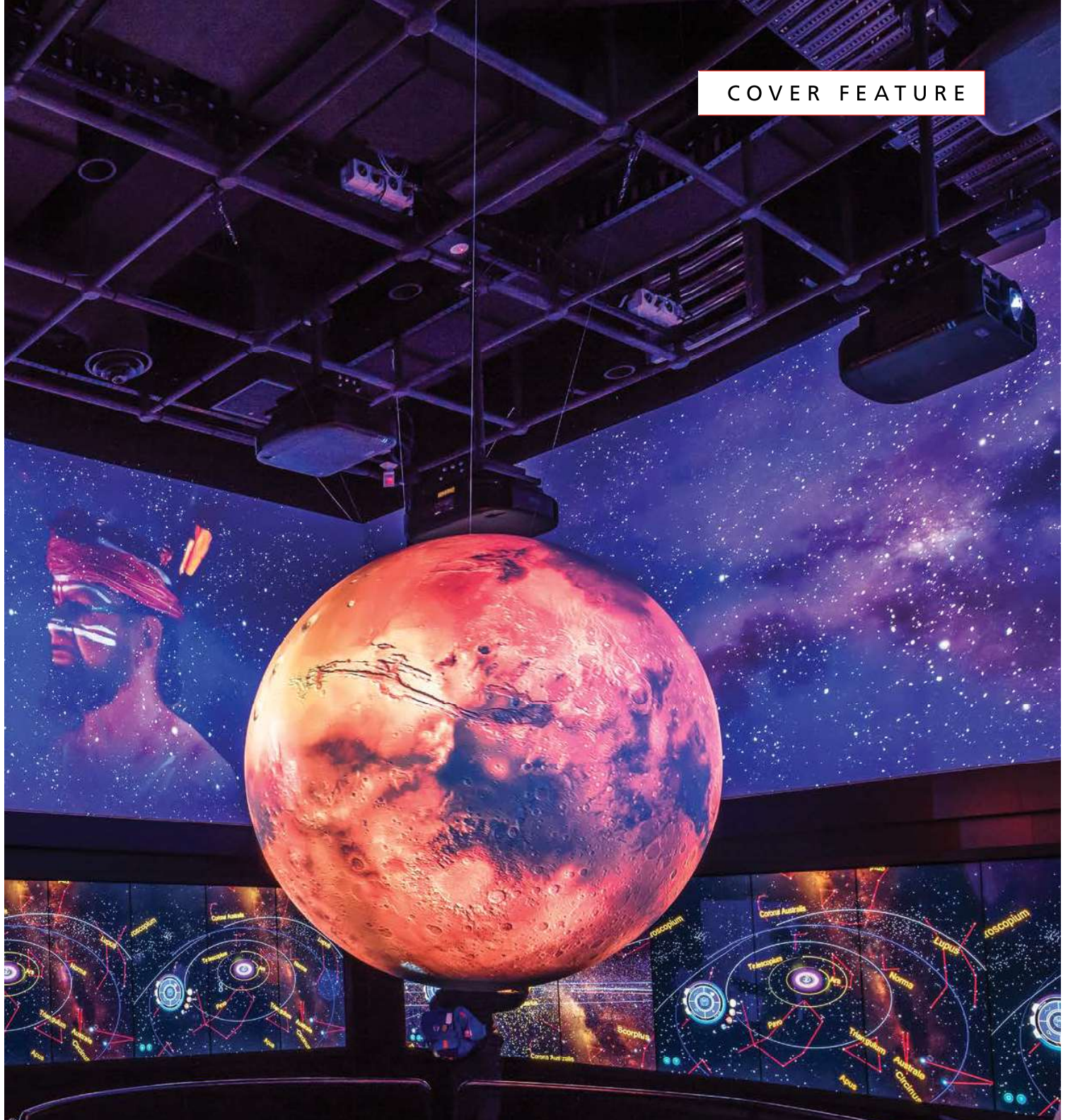
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Community of enquiry



The University of South Australia's Cancer Research Institute introduces a world-class research, teaching and public engagement facility to Adelaide's expanding health and biomedical precinct. As **Sean McGowan** discovered, the services-heavy nature of the building required a holistic approach to its design.



The building is unique in the way it brings together students, researchers, industry and the public.

Image: Peter Barnes.

One in two men, and one in three women, are at risk of developing cancer before the age of 85, with a range of factors including age, lifestyle, exercise and genetics contributing to someone's individual risk.

Given the stark reality of such statistics, it's encouraging to know that much is being done in the field of health research to better understand cancer treatment and possible cures. The construction of the University of South Australia's (UniSA) new Cancer Research Institute may be pivotal to this work.

Since opening in 2018, the facility has become an integral part of Adelaide's \$3.8 billion BioMed City on North Terrace – one of the largest health and life science clusters in the southern hemisphere.

The 16-level building is home to the largest cohort of cancer researchers ever assembled in South Australia.

It will accommodate UniSA's School of Pharmacy and Medical Sciences

and the globally recognised Centre for Cancer Biology – an alliance between UniSA and SA Health.

UniSA's technology-based business incubation hub (a collaboration between the university, DXC Technology and the state government) will also call the building home, alongside the university's Innovation and Collaboration Centre (ICC), and a unique, future-focused Museum of Discovery (MOD).

The building is unique in the way it brings together students, researchers, industry and the public to create a connected and engaged community of inquiry connecting the Adelaide BioMed City precinct to the city.

According to UniSA's vice chancellor Professor David Lloyd, the building is a vital addition to the west end's health and biomedical precinct, helping to boost the links between research, teaching, industry and practice.

"There is now an SA precinct dedicated to excellence in health research and practice, and the building underlines UniSA's leading role in the quest to beat cancer and a range of other diseases," Prof. Lloyd says.

BIOMED GATEWAY

The UniSA Cancer Research Institute is located on the prominent corner of North Terrace and Morphett Street, next to the Adelaide University's Adelaide Health and Medical Sciences (AHMS) building and within close proximity to the Royal Adelaide Hospital and the South Australian Health and Medical Research Institute (SAHMRI).

Designed by architects Swanbury Penglase and BVN, the building features a strong, structural form with vertical fins that act both as structure and sun shading. A smart façade complements the architectural vision to deliver excellent daylighting and the highest standards of energy efficiency.

“As a gateway development to Adelaide BioMed City, the building bears the uniqueness of expression characteristic of architecture to the west while deliberately referencing the formality and verticality of structures that characterise North Terrace to the east,” says Swanbury Penglase architect, Jason Timberlake.

Located on the ground and first floors, the Museum of Discovery (MOD) is Australia’s boldest, and South Australia’s only interactive public science and creativity space that brings together the general public, researchers, students and industry to interact, learn and be inspired.

“MOD helps build a greater understanding of the role of science and technology through interactive and creative spaces.”

On the upper levels of the building, functional areas are focused around three atria, designed to engender a sense of community within the building. Visibility and connectivity at these spaces, and across the work areas, encourages networking and provides a counter-balance to the often isolated nature of individual research.

“Laboratories are arranged with open plan work zones to the perimeter with specialist support spaces central to each zone,” says Timberlake.

“This arrangement enables research groups to grow and shrink with changing research focuses and demands, negating the need to find new accommodation with each research endeavour.”

LEADING BY EXAMPLE

The Cancer Research Institute was designed and constructed to target a certified LEED Gold rating from the US Green Building Council, one of the highest global standards for sustainability.

Unusual for an energy-intensive laboratory facility, the pursuit and achievement of this certification reflects the university’s deep-seated commitment to sustainability.

Involved in the project as part of the principal consultant’s team, Cundall was engaged to manage the project’s LEED certification ambitions.

“Our role was to advocate on behalf of the university for the most energy-efficient solution practical,” says Cundall senior ESD consultant, Lewis Hewton. “And as the specialist sustainability consultant, we were responsible for coordinating the project-wide response to ESD and LEED.”

This included holding early-stage workshops to get buy-in from all disciplines and obtaining sign-off on certification targets and plans from the university.

After initial targets were established, Cundall worked closest with the individual disciplines to ensure LEED requirements were addressed in specifications and design documentation.

“Ensuring the integrity of the ESD response throughout the value management process was a key

ENERGY MODELLING

KBR + Arup were responsible for conducting the energy model needed to secure the LEED Gold rating, and liaised closely with Cundall to ensure all targeted credits were achieved.

This resulted in the incorporation of a number of energy-saving features within the HVAC design such as a high-efficiency plant, energy-recovery systems and run-around coils from the heat-recovery system within the central manifolded exhaust system.

A laboratory air quality monitoring system was also used to allow for a reduction in the number of air changes being provided to a laboratory at times of low occupancy. A night-time setback control strategy linked to occupancy sensors extends the temperature control when spaces are not occupied.

requirement for us, and this meant working closely with all team members and stakeholders to manage the LEED rating contingency,” says Hewton. “We were able to manage a smaller-than-standard LEED contingency through the delivery phase of the project by developing a strong relationship with the contractor, to ensure the maximum number of targeted points were carried through to the final certification.”

This included contractor education sessions, sample reviews, regular site meetings and documentation audits.

“From a building services perspective, the independent commissioning agent (ICA) was fundamental in ensuring the design intent was carried through to commissioning and handover.”

AN INDEPENDENT EYE

Already known to UniSA due to the Green Star ICA project services it provided to the Jeffrey Smart Building, A.G. Coombs Advisory was primarily engaged on the Cancer Research Institute project to provide LEED CxA (commissioning authority) project services.



Functional areas are designed to engender a sense of community.
Image: Peter Barnes.



Given the various functions performed within it, the building is “services heavy”
Image: Peter Barnes.

“We were engaged in late 2014 when the project was still in schematic design,” says A.G. Coombs’ group engineering manager, Warwick Stannus, M.AIRAH.

Stannus says it was exciting to be involved at this early stage, and this allowed A.G. Coombs Advisory to contribute more effectively through the provision of technical reviews that extended well beyond commissioning advice to include constructability advice and safety-in-design assessments.

“We always seek to be involved as early as possible in the design process,” he says. “On this project we also took the lead role in writing the commissioning and handover specifications that were included in the tender services documentation package.”

Through the construction process, A.G. Coombs worked closely with the specialist trades to fully document the commissioning management plan and finalise the inspection test plans (ITPs) and complex integrated fire mode matrix.

“Hansen Yuncken’s project management team supported the commissioning planning and management process,” Stannus says. “And their proactive approach was pivotal to the project’s successful delivery.”

SERVICES HEAVY

Given the various functions performed within the UniSA Cancer Research Institute building – from medical research laboratories to office and administration spaces, teaching spaces, galleries and public amenity –

the building services design is naturally “services heavy”, with a number of different systems and solutions utilised.

The joint venture of KBR + Arup was selected to provide building services engineering through the UniSA consultant tendering process.

IEQ MONITORING

A sophisticated air-sampling system was introduced into the project to measure the air quality in the laboratory spaces.

“From a design perspective, it was important that the ventilation systems not only worked from a functional point of view, but that they did so as efficiently as possible,” says Matt Irlam, Affil.AIRAH, from Air Con Serve.

“We used our extensive sustainability experience to offer alternative design solutions where we could see a benefit to the project, and one such solution was the indoor environment quality monitoring system.”

In a typical laboratory ventilation system, minimum ventilation rates are usually quite high (in the order of six air changes per hour) to account for the levels of particulates, CO₂ and total volatile organic compounds (TVOCs) typically found in these spaces. In the Cancer Research Institute’s laboratories, these minimum ventilation rates were able to be lowered to three air changes per hour because the air is being actively sampled, thereby providing demand control for the ventilation systems.

“With multiple air handling systems delivering in the order of 12,500 L/s of outside air each, the fan and thermal energy savings were quite significant. So as well as being key to reducing energy usage in the laboratories by introducing demand control, the indoor environment quality was also improved.”

Commencing in 2014, the team was responsible for the delivery of the mechanical, electrical, ICT, security, hydraulic and fire protection services, as well as providing specialist advice in the fields of fire engineering, acoustics and hazardous goods storage.

“KBR + Arup were involved from the start of the project with stakeholder engagement, and provided advice on the building form and spatial requirements necessary for the building services,” says KBR building services manager, Julien Pachot.

“This involvement continued through the design and construction phases.”

The building is primarily served by a central, water-cooled chilled water system comprising high-efficiency centrifugal chillers and corresponding cooling towers for heat rejection. Heating hot water is provided by condensing-type boilers.

According to Pachot, the building’s HVAC design is divided into three distinct parts.

The three atria are served by local chilled and heating hot water fan coil units (FCUs) that discharge air horizontally via wall-mounted supply air grilles, while the MOD gallery areas are served by chilled and heating hot water air handling units (AHUs) with humidity control where required.

The AHUs are fitted with enthalpy wheels to assist with pre-heating and pre-cooling by using the return/relief air to pre-treat outside air.

The “write-up” areas adjacent to the laboratories are served by active chilled beams with outside air provided via 100 per cent outside air chilled water AHUs. Local heating is provided at the beams. Enthalpy wheels are again used in the pre-treatment of outside air.

Laboratory areas, meanwhile, are served via 100 per cent outside air, chilled water AHUs with local reheat provided via duct-mounted heating hot water coils. The AHUs are also provided with run-around coils from the heat-recovery system installed within the central manifolded exhaust system.

“The laboratory spaces’ supply and exhaust-air systems incorporate a laboratory airflow control system consisting of venturi valves both on the supply and exhaust system, modulating up and down to suit

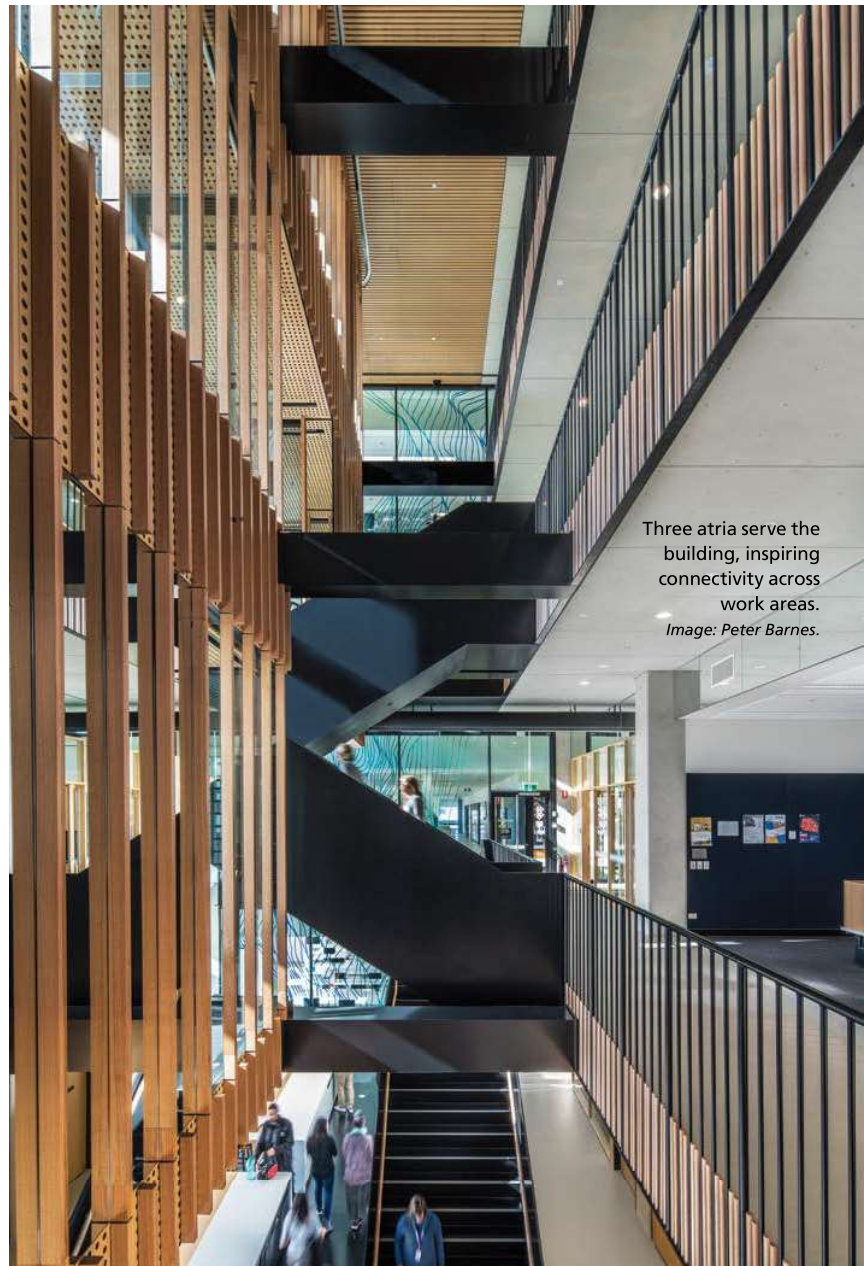
thermal and/or exhaust requirements in order to maintain the volumetric offsets required to meet the PC2 requirements of the facility.”

As well as being selected as the most energy-efficient solution to suit the LEED requirements, this latter solution has been proven to work well when used previously on the Westmead Hospital project in Sydney’s western suburbs.

The building’s chilled water plant is located at Level 12, and comprises two 1,900kW centrifugal chillers and one 920kW centrifugal chiller for low-load and emergency power operation.

The system’s associated heat rejection plant is located on the rooftop, and consists of four 1,400kW induced draft, counter-flow cooling towers connected to a common condenser water system serving the chillers to provide redundancy. The boiler plant for heating hot water is also located on the rooftop, and comprises two 860kW condensing type boilers.

Chilled and heating hot water is reticulated to all the various plant and equipment throughout the building via centrifugal pumps, which are all located within their respective chiller and heating hot water plant rooms.



Three atria serve the building, inspiring connectivity across work areas.
Image: Peter Barnes.

LESSONS FROM THE COMMISSIONING AUTHORITY

A.G. Coombs' group engineering manager, Warwick Stannus M.AIRAH, offers some of the opportunities for learning from the UniSA Cancer Research Institute.

"The real lessons on this project relate to project team management and creating a common sense of purpose, supported by the right procurement model," Stannus says.

"I am sure that UniSA could have delivered a cheaper project but not a better outcome for the university, and now their investment is paying dividends in terms of built performance and a new best-in-class research facility that will meet their long-term objectives."

Investment in good design and design documentation always pays dividends when delivering complex projects.

It is important that the design team remain **actively engaged** through the construction and commissioning phases of the project. The value that KBR provided through the project delivery was immense.

While LEED is a more internationally recognised sustainability rating scheme, it introduces some **specific challenges and complexities** that need to be understood by the client and project team.

Every major project team should have a project debrief following practical completion, involving the client and the project design and construction teams. With an appropriate charter, valuable lessons can be learnt by all parties to deliver better projects in the future. If the project team don't want to be involved, then fundamentally the project has failed in some important dimension. Every project has its challenges, but we should learn from every project, share the lessons and celebrate the wins. As an industry we don't do it enough.

OVERCOMING CONSTRAINTS

With the building bordered by a rail corridor to its north, a main arterial elevated road to its east and a tram line to its south – and building height restrictions also in place – the location of mechanical services plant was paramount.

Following an early review that considered both floor-by-floor and central plant designs, the latter was adopted on the premise that it would impact less on the laboratory floor plans and the functionality of these spaces.

"The other key challenge was the constructability of the main air-side riser, due to the site constraints," says Pachot.

"It resulted in having one main central riser serving all the laboratory and lower floors located on the eastern end of the building," he says. "However, the challenge was that this riser was bordered on the south by a sheer wall that could not be easily penetrated, as well as the lift core on the east and a staircase on the north."

This meant that all ductwork was required to both enter and exit via the west of the riser.

"Early in the design stage it was recognised that the installation of the riser was going to be difficult and time-consuming using traditional methods," Pachot says.

Rather, the concept of an off site prefabricated riser concept was devised, tested and adopted.

Pachot says this method saved up to three months in the construction program.

BUILDING MANAGEMENT

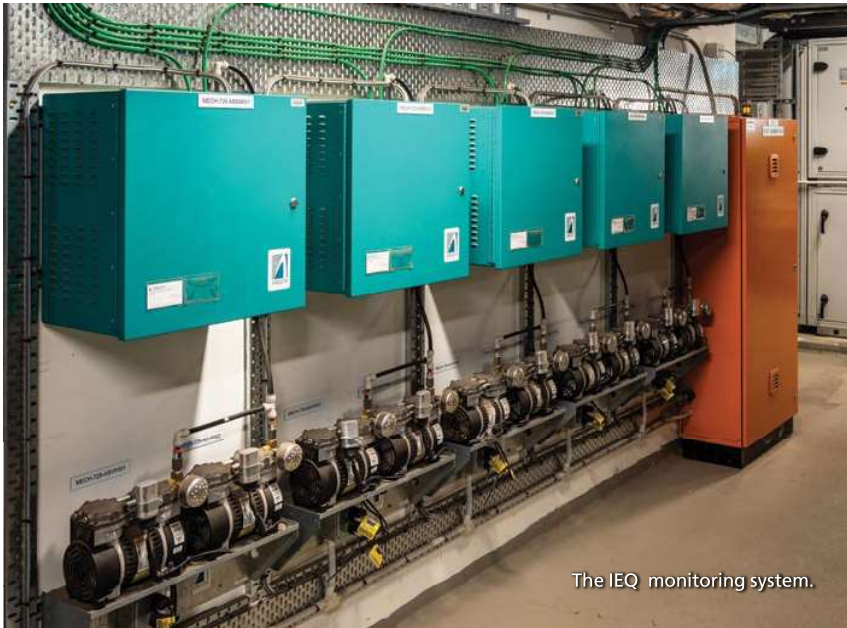
As the incumbent BMS service provider to UniSA, Air Con Serve were engaged during the design phase to provide engineering advice on the structure of the facility's building management system (BMS), to support the outcomes the university was seeking.

"The client identified early on that the BMS was going to be a critical element in this building, and therefore wanted to ensure we played an active role," says Air Con Serve project manager, Matt Irlam, M.AIRAH.

Engaged directly by the developer, Air Con Serve worked collaboratively to ensure the BMS would underpin the requirements of the LEED Gold certification.



A central plant room (rather than a floor-by-floor approach) minimises the impact on laboratory design.



The IEQ monitoring system.

“To use a common metaphor, the BMS should not be a square peg that’s trying to fit a round hole,” says Irlam.

“Our approach to the project was to listen to the client and understand what outcomes they were trying to achieve, and then provide the engineering solutions to facilitate this. We could then work backwards from the solution, to support the design team in scoping all the trade packages – making sure the necessary hardware was being installed so that the finished product was a building fit for purpose.”

The manifolded exhaust system, incorporating multiple fans and dampers in N+1 configuration, proved particularly challenging from a controls perspective. Both systems needed to work in harmony to maintain a constant static pressure in the main laboratory exhaust riser.

As a consequence, the algorithm behind the staging of the fan systems was necessarily intricate to ensure it was reactive, without being aggressive.

“Due to the connected fume cupboards, minimum discharge velocities needed to be controlled but conversely, plume heights were also an issue, as the building is in the flight path of Adelaide’s main airport,” says Irlam.

Given the commissioning of this system would be critical to the handover of the building, Air Con Serve engineers held multiple design workshops to troubleshoot potential control issues.

The whole control strategy was also bench-tested in their workshop with working dampers and limit switches to perform real-world scenarios likely to be encountered onsite. (See Energy modelling breakout on page 35).

Similarly, the laboratory airflow control system (LACS) – while a separate and distinct system to the BMS – presented controls challenges given it is at a network level controlled by the same platform as employed by the BMS.

Planning of this integration commenced well before a cable was installed onsite.

“We worked very closely with Viscon Systems to help develop the LACS network architecture and streamline the integration into the BMS,” says Irlam. “For the university, it was important that the data emanating from the LACS system meshed seamlessly with the rest of the mechanical equipment controlled by the BMS.”

Among the UniSA Cancer Research Institute’s key sustainability attributes is the ability for the BMS to provide load-shedding control.

Under normal power, the BMS responds to current power prices on the spot market and controls the building loads to minimise power usage in periods of peak power pricing. It even has the ability, if required, to automatically start the diesel generator and transfer both of the large 1,900kW chillers to reduce electrical demand.

Irlam says that in a failure of normal power supply, the BMS controls the thermal load within the building to ensure the conditions in critical spaces, such as -80°C freezer rooms, constant temperature rooms and the building’s vivarium are maintained.

Housed on an entire floor, the vivarium is a space used to house animals for research and observation.

This space also presented a number of challenges to the controls team, not least of which was to ensure all requirements of the Office of the Gene

LESSONS FROM THE ESD CONSULTANT

Cundall principal ESD consultant, Lewis Hewton, offers some lessons learned from the pursuit of LEED Gold certification at the UniSA Cancer Research Institute.

Be proactive. If a design decision has the potential to impact the LEED outcomes, the risks and implications need to be fully explored and communicated to all involved. The alternative of passively managing LEED projects requires a higher contingency on the target points and leads to higher project costs without guaranteeing better environmental outcomes.

Quantify everything. If we save X dollars by doing Y, exactly how does that impact the LEED rating? Do we have to target other credits? What are the costs and benefits of doing that?

Do one thing at a time. There about 45 credits contributing to the LEED rating, and each credit is made up of multiple requirements. Identify the one issue that can be resolved right now, find out who needs to be involved and make it happen.

LESSONS FROM THE BMS SERVICE PROVIDER AND CONSULTANT

Air Con Serve project manager, Matt Irlam M.AIRAH, shares the company's experience providing engineering advice on the Institute's BMS structure.

Engage in dialogue with your incumbent service providers up front to assist the design team. Build upon the knowledge of your service providers who understand your buildings and the operational expectations of the people who occupy them.

One of the drivers of the success of this project was the client's ownership of the design and active involvement throughout the project life-cycle. Key to this was appointing a managing contractor who facilitated inclusive dialogue between all members of the project team. Drawing on the collective experience of the group yielded the best design outcomes.

Seek opportunities to value-add for your client. Be involved in the outcome. Opportunity risk may provide a shared benefit for all.

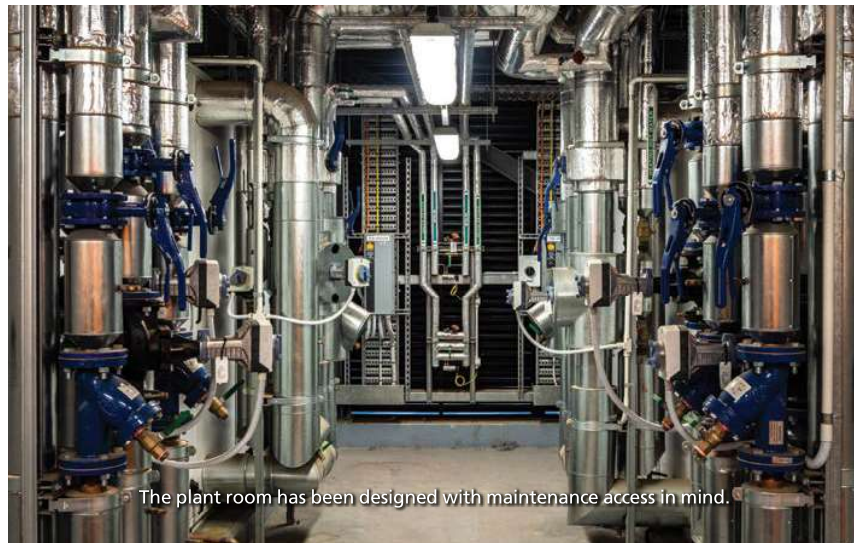
BIM is a brilliant tool and crucial for a build where spatial constraints are an issue. Exclusion zones around components need to be modelled to ensure free access for servicing. It's important to have your service team review the model, and to verify if the allowable access is practical and equipment is maintainable.

Don't be afraid to embrace new technologies. It will encourage innovation and rapid advancements in your organisation if managed well. While it will undoubtedly challenge your team and your systems, it will also provide tangible benefits for your organisation and your client.

Technology Regulator (OGTR) were met. Also having to be satisfied were the requirements of the Animal Ethics Committee, which would ultimately certify the facility to accept animals.

Irlam says the team's testing was required to be methodical and robust to pass the inspection.

"We were acutely aware that we would have one opportunity to commission the vivarium, and it had to be right the first time," he says. "For us, this meant rigorous testing and working closely with the mechanical contractor to methodically commission the air and water systems serving this floor."



The plant room has been designed with maintenance access in mind.

He says a simple and concise cloud-based spreadsheet of unresolved issues was kept open and shared among the team. Through an iterative process, each item was actioned by the responsible team member and closed out.

And given the critical nature of the research material and equipment used within the laboratories of the building, Air Con Serve also collaborated with UniSA to develop a critical equipment monitoring system (CEMS).

This provides the users of a laboratory with visibility and active notification of equipment conditions, reducing the risk of valuable work being lost or set back due to equipment failure or a change in conditions.

RIGHT TEAM, RIGHT PLACE

The \$247 million UniSA Cancer Research Institute opened its doors on May 10, 2018, with a plaque unveiling by the Premier of South Australia, Steven Marshall.

The building has reportedly performed well since occupancy, with a number of occupancy surveys returning very positive feedback. And while it is too early to compare actual energy data to the predicted energy model, KBR's Pachot says early indicators show that the building is on track to meet predictions.

A project of the complexity of the UniSA Cancer Research Institute could not be delivered successfully without the client's leadership, and a project team that is both engaged and willing to contribute collaboratively and proactively.

"While the breadth and complexity of the services provided in this single research facility is rare, what was more remarkable ... was how the project team worked collaboratively to deliver this project," says Stannus from A.G. Coombs Projects. "Much of the credit goes to the leadership and commitment of the UniSA project management team."

He says the university's focus on engaging the right team and right project delivery model for such a complex project was pivotal.

It is a view supported by the project team, including Air Con Serve.

"UniSA are masters of inclusive projects," says Irlam. "While they are mindful



of cost, they do not let it compromise the quality outcomes they strive for. They understand that having a well-functioning facility is key to attracting students and world-class research, and as clichéd as it sounds, you get what you pay for.

“There was great synergy within the group, and the proof is in the results.”

LEED Gold certification was formally awarded by the USGBC in March 2019, fulfilling the University of

South Australia’s determination and commitment to delivering a sustainable and energy-efficient facility.

“We are extremely proud of the building and the research teams who work here and dedicate their lives to finding solutions for some of the world’s most devastating health problems,” says Professor Lloyd.

“When you give your best minds the best facilities, you can expect they will deliver the best research outcomes.” ■

LESSONS FROM THE BUILDING SERVICES ENGINEER

KBR’s manager of building services, Julien Pachot, shares three lessons from the firm’s work on the UniSA Cancer Research Institute.

Planning well and having an early engagement of all the stakeholders and end-users is paramount in delivering a fit-for-purpose building. This was implemented on this project and resulted in very little re-work once the end-users moved in, as they knew what they were getting.

Keep the smoke spill systems separate. In our case, we did not manage to do it due to space constraints, hence the central manifolded exhaust system doubles as the smoke spill. Although the systems are performing and achieving compliance with all the relevant codes and standards, it added an extra layer of complexity in the design and commissioning due to the inherent specific requirements associated with fire and life safety systems.

Collaboration and teamwork are paramount in achieving such a complex project, and this was true during both major phases of the project. During the design phase we benefitted from having the managing contractor and some of the key sub-contractors engaged early to provide advice. During the construction phase, the team stayed fully engaged with the trades to provide valuable insight as to how the design was intended in order to achieve a “best for project” approach.

PROJECT AT A GLANCE

The personnel

- ▲ Architects:
Swanbury Penglase + BVN Donovan Hill
- ▲ Building automation and controls:
Air Con Serve
- ▲ Building services engineers:
KBR + Arup
- ▲ Cost manager:
Rider Levett Bucknall (RLB)
- ▲ ESD consultant:
Cundall
- ▲ Façade engineer:
Arup
- ▲ Independent commissioning agent:
A.G. Coombs Advisory
- ▲ Managing contractor:
Hansen Yuncken
- ▲ Mechanical services contractor:
A.G. O’Connor
- ▲ Project managers:
UniSA Facilities Management
- ▲ Structural and civil engineer:
Wallbridge Gilbert Aztec (WGA)

The equipment

- ▲ AHUs:
Carrier AHI
- ▲ BMS:
Tridium, Distech, Schneider
- ▲ Boilers:
Aira
- ▲ Chilled beams:
Halton
- ▲ Chillers: **Powerpax**
- ▲ Cooling towers: **BAC**
- ▲ Diffusers: **Holyoake**
- ▲ Duct: **Tinman (now Kavanagh Industries)**
- ▲ Fans: **Fantech**
- ▲ FCUs: **Carrier AHI**
- ▲ Fume cupboards: **Dynaflow**
- ▲ Grilles: **Holyoake**
- ▲ IEQ monitoring system: **Aircuity**
- ▲ LACS: **Phoenix Valves**
- ▲ Pumps: **KSB**
- ▲ VAV boxes: **Celmec**

(Source: KBR)