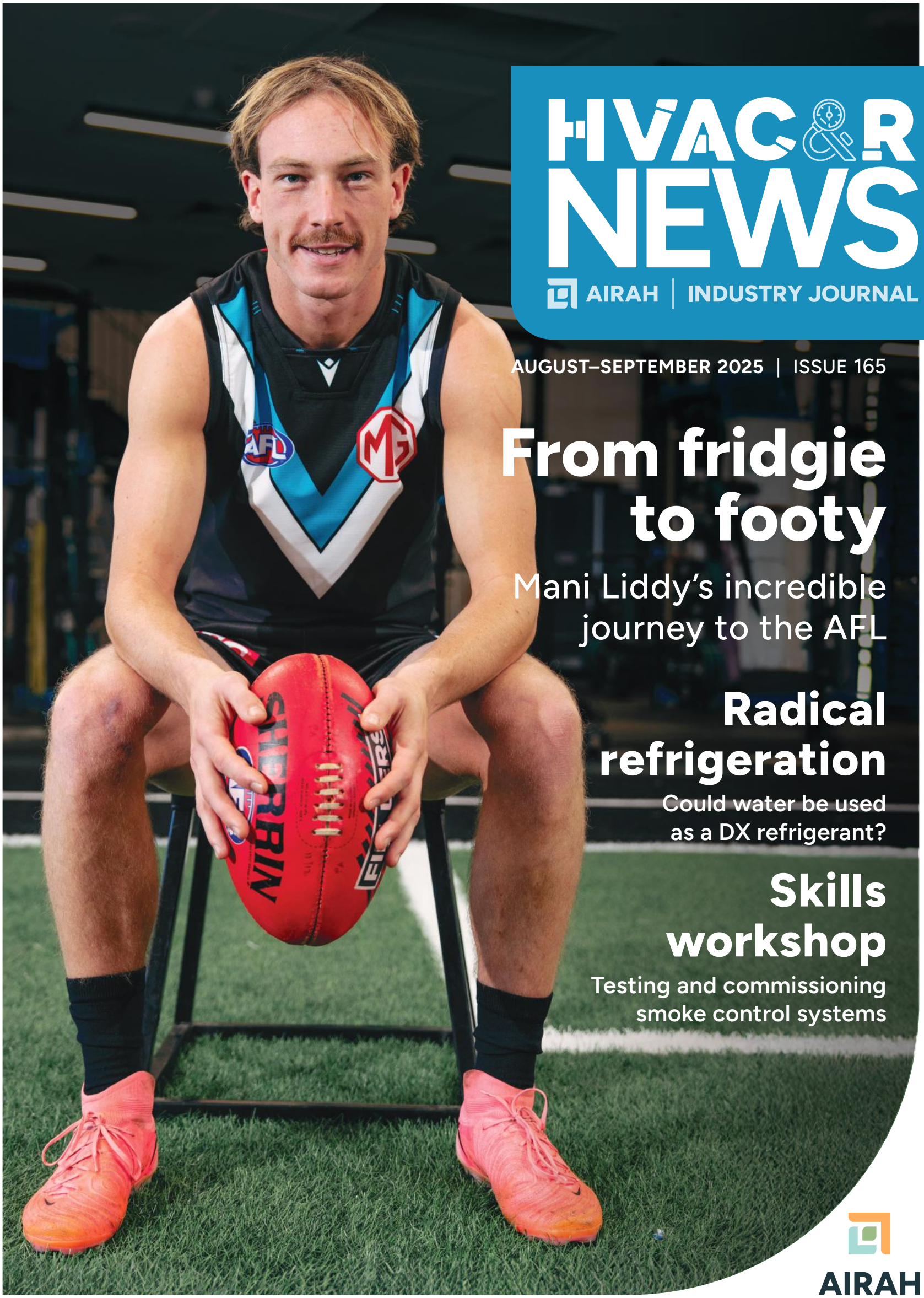

# HVAC&R NEWS

AIRAH | INDUSTRY JOURNAL

AUGUST–SEPTEMBER 2025 | ISSUE 165

## From fridgie to footy

Mani Liddy's incredible journey to the AFL

## Radical refrigeration

Could water be used as a DX refrigerant?

## Skills workshop

Testing and commissioning smoke control systems

AIRAH

PRINT POST APPROVAL NUMBER PP 727272/60606

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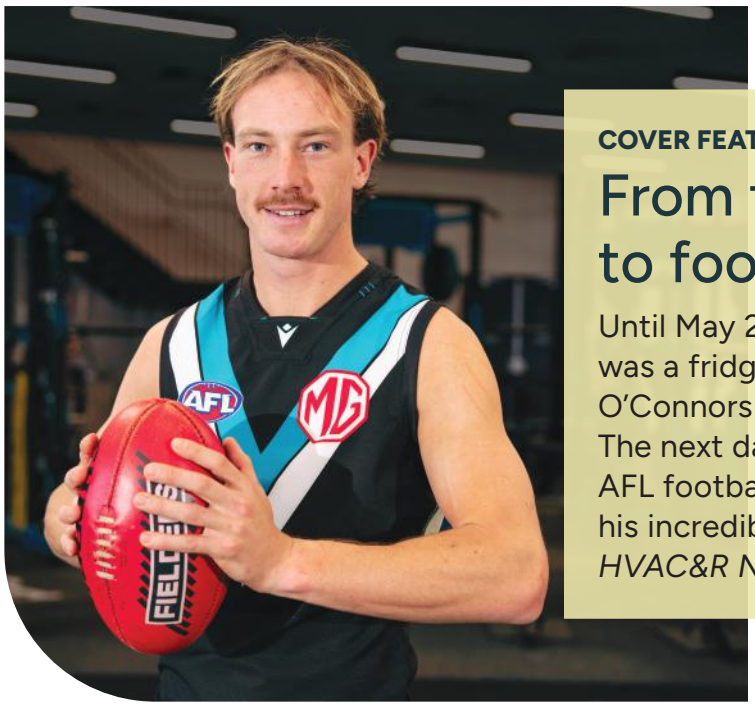
August–September 2025
ISSUE 165



COVER FEATURE

## From fridgie to footy / 19

Until May 27, 2025, Mani Liddy was a fridgie working for O'Connors in South Australia. The next day, he became an AFL footballer. Liddy shares his incredible journey with *HVAC&R News*.

EXCLUSIVE TO THIS ISSUE

## Radical refrigeration / 24

Dave Peall, M.AIRAH, discusses his research into using water as a direct expansion refrigerant, with potential future applications in residential settings.

## Regular articles



HVAC&R SKILLS WORKSHOP

Testing and commissioning smoke control systems / 15

Cover photo by Brooke Bowering


AIRAH

*HVAC&R News* is published by the Australian Institute of Refrigeration, Air Conditioning and Heating (Inc).

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ISSN 1834-9522

# Standard of living

## Over the past week, I've been consuming a lot of pingers ...

Before you jump to the wrong conclusion, let me clarify. By "pingers", I mean Purple Pingers (real name Jordan van den Lamb), the rental rights advocate and senate candidate who has gained fame for his reviews of substandard Australian rental properties. By "consuming", I mean watching his videos on YouTube.

If you've ever felt disenfranchised with the experience of renting a home, it's worth watching these videos. They show that, in many parts of Australia, $500+ per week in rent gets you black mould, rising damp, broken appliances, major structural issues, and vermin infestation.

One of the most common phrases you'll hear in Purple Pingers' videos is "minimum rental standards". These standards vary from state to state, but their role is essentially to ensure that properties are safe and decent to live in. It's clear that these standards are commonly not met, with little or no consequence for the landlord or the agent.

As I was watching these videos, I thought back to my first rented share house, which I daresay fell short of quite a few minimum rental standards.

There was the hole in the floor beneath the living room carpet, which caused some quite entertaining stumbles during parties.

The substantial cracks in the walls, which offered more ventilation and natural light than any of the windows.

The boiler that never managed to heat water past lukewarm.

The ancient gas heater, which roared like a freight train and emitted a worrying smell.

I remember trying to report these issues to the real estate agent, who was arrogant and dismissive. The only way I could ever get issues resolved was to frame them as immediate safety hazards.

In situations like this, HVAC equipment and expertise can make a world of difference. In some states, having a fixed heater – such as a reverse-cycle air conditioner – in the living area is mandatory in all rentals.

A splitty can't solve all the problems we've touched upon. But it does provide cooling in the height of summer and heating in the depths of winter, both of which are hugely important for people whose houses aren't offering the safe shelter they should.

I'm happy to report that the stories in this issue of *HVAC&R News* explore much brighter topics. Our cover star is Mani Liddy, the former fridgie who has traded in his tools for footy boots as Port Adelaide's newest midfielder.

We also learn about water's potential as a DX refrigerant with Dave Peall, M.AIRAH, look at strategies for successful tenders with Lara Blake, and hear from Darren Bee about the energy-saving potential of HVAC zoning. Our skills workshop focuses on testing and commissioning smoke control systems.

AIRAH's ambitious motto is "HVAC&R for a better world". Sometimes, HVAC&R for a better home is just as important.

**Nick Johns-Wickberg**
EDITOR
nick.johnsw@airah.org.au

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APAC Case Study

# APAC delivers its largest, most powerful customised HVAC suite to Pilbara region

## Background

With over 50 years of proven expertise, APAC, Rinnai Australia's commercial HVAC brand, continues to lead the market in delivering custom-engineered systems for mission-critical environments.

Designed and built in Melbourne, APAC's HVAC systems are trusted across sectors including mining, defence, hospitals, shopping centres and large public spaces. Their in-house engineering and manufacturing capability enables responsive, high-quality solutions tailored for the Australian landscape. Thanks to a deep understanding of Australia's harsh climate, APAC's customised HVAC solutions have been the leading choice for many high-profile projects across Australia.

The Project Ceres Urea Plant by Perdaman Industries is a significant new chemical and fertiliser production site scheduled for completion in 2027. Located on the Burrup Pensinsula in the Pilbara region of Western Australia, this remote and challenging site required a highly robust HVAC system to ensure reliable performance in conditions such as extreme heat, dust and chemical exposure.

## Challenge:

The Burrup Peninsula is known for being one of the most climatically extreme regions in Australia. High temperatures, corrosive salty air and frequent cyclonic weather conditions can seriously compromise the long-term performance, reliability and maintenance schedules of equipment such as HVAC systems.

Vital to operations at Project Ceres were the facility's switch rooms which would require strict climate control to meet site-specific certifications and important safety, productivity and compliance standards. The chosen solution would undergo rigorous testing by independent auditors and certifiers.

"The unique environmental challenges of the site and high performance expectations of the project meant that a standard off-the-shelf HVAC solution wouldn't be sufficient," remarks Dale Watkins Group Manager – Commercial Sales, Rinnai Australia.

> Whether it's fully customised systems or standardised high-end packages, APAC delivers reliable commercial HVAC solutions built for performance in Australia's toughest conditions.

"And, as with many projects of this scale, timing was an important factor. The chosen HVAC solution needed to be designed, implemented and tested with precision to meet strict requirements."

## Solution:

With a large manufacturing facility in Melbourne and a 236-person, dedicated in-house engineering and manufacturing team, APAC was the ideal partner to cater to the unique needs of the project. Local production allowed for tight control over design elements, quality and lead times.

In just 16 weeks from briefing, APAC designed, manufactured and delivered its largest and most powerful customised suite of HVAC units on record, comprising twenty-six 230kW systems, four 170kW systems and several smaller units.

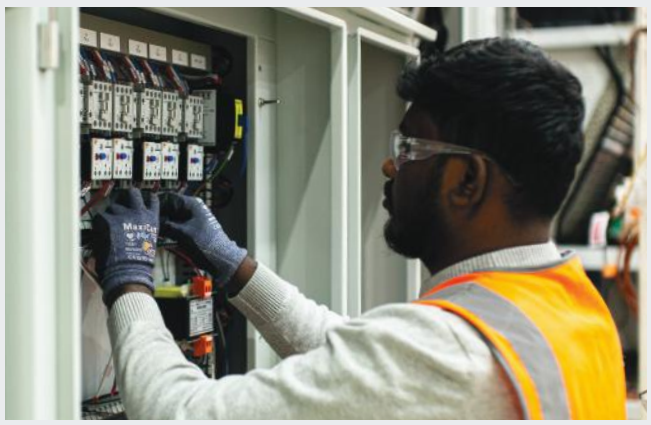
These systems were manufactured across four dedicated production lines and were tested to APAC's stringent QA protocols to ensure every unit met or exceeded the required performance standards.

A key customisation to the units was the full 304-grade stainless steel casing with powder coating which offers enhanced corrosion resistance. Additional coil protection ensures the systems are robust enough to withstand the sites tough weather conditions .

Other tailored modifications included the use of German-engineered fans to meet airflow specifications and efficiency requirements as well as advanced filtration systems to maintain long-term performance in dusty, chemical-rich environments.

Close collaboration between APAC's engineering team and the client was a key factor in the successful delivery of the project's HVAC solution. From design through to commissioning, APAC's local team held multiple planning and customisation sessions to ensure the solution met all operational and environmental criteria. They also worked alongside partners to manage timelines, delivery and final implementation.

"The solution that APAC delivered will ensure reduced maintenance costs, improved reliability and longevity in one of the world's most demanding operational environments," says Dale. "We look forward to working with our partners to play an even larger role in the future of Project Ceres."



Scan to learn more about APAC customised solutions.

**www.apacair.com.au**

apac by Rinnai

## Cutting-edge tech

Allvent Ventilation Products has introduced the HVLS Hyperblade series, which it says is appropriate for spaces like warehouses, fitness centre, cattle sheds, and airport terminals.

The fan series is available in in five sizes from 3,000–7,000mm and offers reversible airflow for summer and winter applications, as well as EC brushless motors with integrated drivers.

According to the company, the anodised aluminium blades maximise airflow – up to 330,800m³/h. Allvent says the fans are rated IP65 and engineered to operate in temperatures from -10°C to +50°C, making them appropriate for harsh industrial or agricultural environments.

allvent.com.au

panasonic.com.au

## Neat pump

Panasonic has launched its new air-to-water heat pump system, which it says offers a compact and efficient alternative to traditional gas or oil boilers.

The unit operates without an indoor system, using only hydraulic piping, which simplifies installation. It is compatible with underfloor heating, radiators, and fan coil units.

The system is available in a range of models, including the J Series (9kW and 16kW) for compact applications and the T-CAP series (12kW and 16kW) for conditions down to -20°C. Panasonic says the system delivers a consistent water output temperature of 60°C, even in low temperatures, by operating under higher pressure within the refrigerant cycle.

## Manifold destiny

Sauermann has launched two new manifolds, along with their probes and connected accessories. The company says the manifolds are appropriate for domestic and industrial heat pumps, air conditioning, refrigeration and reversible systems.

According to Sauermann, the Si-RM350 and Si-RM450 manifolds measure temperatures, pressures and vacuum, as well as psychrometric air parameters (indoor, outdoor and in ducts).

Sauermann says the supporting digital technologies incorporate a stable wireless connection up to 100m away, and temperature probes equipped with a new parrot-beak-shaped clamp that ensures optimal contact on pipes from 6–42mm.

sauermanngroup.com

## New fans

Blauberg Ventilation has released a new range of EC 150 and 200mm mixed flow inline fans, as well as an EC ceiling header box fan, for NCC and NCC Section J compliance.

Blauberg says its new range comes with EC motors, a built-in 0–10V speed controller for easy commissioning of the fan to NCC Section J compliance, and a fixed 12-minute run-on timer with a four-pin lead and plug for NCC compliance.

The company says this range – designed and manufactured in Europe – is appropriate for apartments, medium to high density housing, and retirement villages.

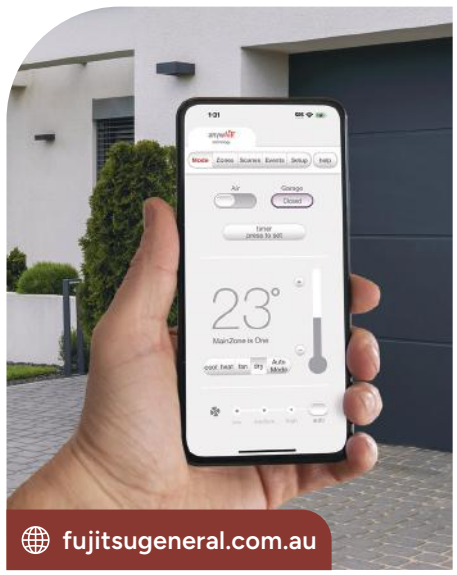
blaubergventilation.com.au

## Bionic boost

Ziehl-Abegg has released its new ZAplus fan unit, which it says has enhanced bionic features that reduce noise and energy consumption. The company says the serrated trailing edge of the ZAplus fan blade has a gently wavy leading edge that keeps airflow attached to the blade longer, further reducing noise by up to 4dB(A).

Despite retaining the standard outer diameter of 1,070mm, the internal diameter has grown from 910 to 960mm, which the company says improves efficiency. The rotor is now made of aluminium, while the blades are produced using high-strength plastic.

ziehlabegg.com




fujitsugeneral.com.au

## Pleasant air anywAiR

Fujitsu General has released the next generation of its anywAiR ducted controller, now featuring optional garage door control and sensor functionality. The company says the updated anywAiR controller integrates ducted air conditioning control with the ability to monitor and operate compatible garage doors via the anywAiR app.

The system supports VAV and temperature-controlled zoning, as well as a sleep economiser mode that automatically shifts from cooling to fan mode overnight to reduce energy use.

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## Free standards soon?

Australian construction leaders have met with Standards Australia at Parliament House in Canberra, with free access to standards on the agenda. The organisations that met with Standards Australia were the Australian Sustainable Built Environment Council, Master Builders Australia, Master Plumbers Australia and New Zealand, Master Electricians Australia, Housing Industry Association, and the National Electrical and Communications Association (NECA).

In a joint statement, the organisations acknowledged that access to standards is a critical issue impacting safety, productivity, workforce capability, and the delivery of housing and infrastructure. The statement floated the possibility of free access to online standards in the future.

standards.org.au

## Cold storage squeeze

Australia's cold storage sector is under increasing strain, with vacancy rates falling to just 0.6% – well below the national logistics and industrial average of 3.0%. New research by Cushman & Wakefield reveals a shortfall of approximately 130,000m² of space, with further pressure anticipated as ageing facilities fail to meet current tenant standards.

According to the *Frozen Logistics* report, the country's cold storage footprint stands at 3.1 million m². However, roughly 15% of these facilities are no longer fit for purpose, and this figure could rise to 25% by the early 2030s due to evolving tenant requirements, including automation, sustainability, and flexible operations.

cushmanwakefield.com

## TACA annual seminar

The Testing and Commissioning Association (TACA) will hold its annual seminar on Friday, October 3 at The Cluster in Melbourne.

The all-day event will include presentations from 9am–4pm and social drinks after 4pm.

Sessions include:

- Airtightness testing – ATTMA
- Flushing and filling hydronic systems
- ICAs and their role in commissioning – Trevor McGrath (ECG)
- Building electrification – Jamie Park (A.G. Coombs)
- Instrument certification requirements – TACA
- Company accreditation – TACA
- Members' discussion/open forum

taca.org.au


## Gender equality pledge

Industry leaders across Australia's plumbing industry and adjacent sectors – including HVAC&R – have signed a pledge for change to build inclusive, respectful workplaces and open new opportunities for future tradespeople.

The pledge was signed at the official launch of *Building Futures: Breaking Barriers*, a three-year initiative led by the Plumbing Industry Climate Action Centre (PICAC) in partnership with 10 unions, employers, industry bodies and industry training organisations from across the sector.

While the pledge focuses on plumbing, the inclusion of the Air Conditioning and Mechanical Contractors' Association (AMCA) means the HVAC&R industry is also represented.

"If we want to build a future-fit plumbing and HVAC workforce, we need to make space for different people, different perspectives and different pathways into the trade," says AMCA CEO Scott Williams.

picac.edu.au

## Gold for ARC

The ARC has received a gold medallion from WorldSkills Australia, honouring its partnership and support for refrigeration and air conditioning skills excellence across the country.

The ARC's collaboration with WorldSkills Australia spans several years, during which the organisation has contributed to national and international competitions that empower young Australians to pursue careers in various trades.

"We are deeply honoured to receive this recognition from WorldSkills Australia," says ARC Technical & Training Manager Noel Munkman, M.AIRAH.

The ARC's involvement has included sponsorship of regional, national and international competitions, and direct engagement with apprentices and educators.

arctick.org

## Keeping it clean

Giant Hygiene Services has launched in NSW and the ACT as an independent occupational hygiene consultancy specialising in the scientific assessment of air, water, and indoor environments.

The newly formed company aims to help organisations stay compliant and support the wellbeing of building occupants, whether for an office building, healthcare facility, school, or commercial space.

Giant Hygiene Services is led by Gregor Riese, M.AIRAH, an environmental scientist and occupational hygienist with over 25 years of experience across government, private, and industrial sectors.

giantcorp.com.au

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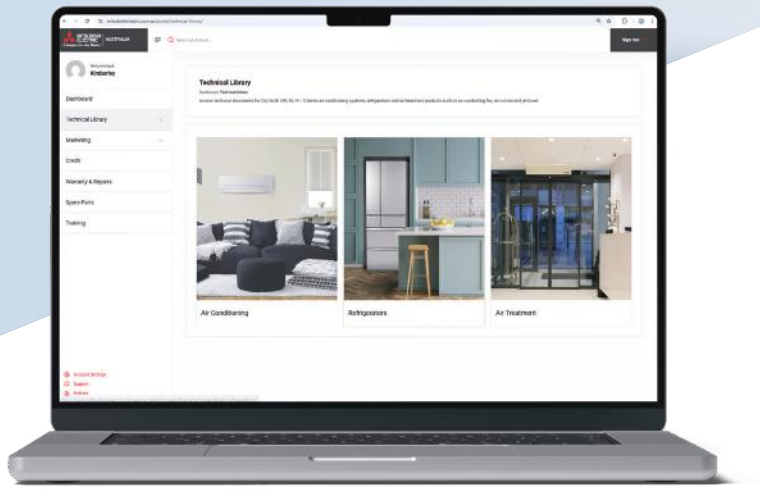

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# AIRAH launches Women in HVAC&R Summit

## The first iteration of the annual event will take place at the Ivy Ballroom in Sydney on Friday, October 24.

AIRAH's Women in HVAC&R Summit is a new annual event celebrating the involvement of women and gender-diverse people in Australia's HVAC&R industry.

This gathering will bring together industry leaders, advocates, and professionals to explore how fostering a more inclusive workforce drives innovation and growth. Attendees will hear from dynamic speakers on breaking down barriers for underrepresented groups with a primary focus on including women in the industry.

Pam Rogers

## Opening speakers

Australian Sustainable Built Environment Council (ASBEC) CEO Alison Scotland will deliver the keynote address. Alison will reflect on her own journey and experiences within the construction industry, touching on topics such as overcoming challenges, career trajectory, and improving retention in leadership roles.

Next up is SP&R Air Conditioning General Manager Pam Rogers, whose presentation will focus on how women can navigate their career progression within the HVAC&R industry.

Pam is particularly qualified to talk about this, having begun her career as a fridgie and worked her way up to a senior management position at SP&R Group, which won the 2024 AIRAH Award for Excellence in Diversity and Inclusion.

## Women of AIRAH STG

Established in 2016, the Women of AIRAH (WoA) Special Technical Group works to develop AIRAH's strategy for supporting women and increasing their participation in both AIRAH and the Australian HVAC&R industry at large.

If you'd like to learn more about the WoA or join the group, scan the QR code.

## Event details

**Date and time:**
Friday, October 24
– registration opens from 8am

**Location:**
Ivy Ballroom,
Level 1/320 George Street,
Sydney

**Registration:**
$180 for AIRAH members,
$210 for non-members
– available until October 21, 2025

**Speakers:**
Alison Scotland, ASBEC
Pam Rogers, SP&R Air Conditioning
Diana Burgess, Lendlease
Megan Dinsdale-Jones, Cool-Safe
Madeleine Moratti, A.G. Coombs
Liza Stokes, NDY

**CPD points:**
5

## Interactive session

After the plated breakfast and networking session, things will take a slightly different turn, with an interactive session exploring the value of mentorship and trade-based career options for women in building services. The session will be held in collaboration with the Fire Protection Association of Australia (FPAA).

Attendees will be encouraged to mingle, share their own experiences with mentorship or menteeship within the industry, and connect with other present or future leaders in the room.

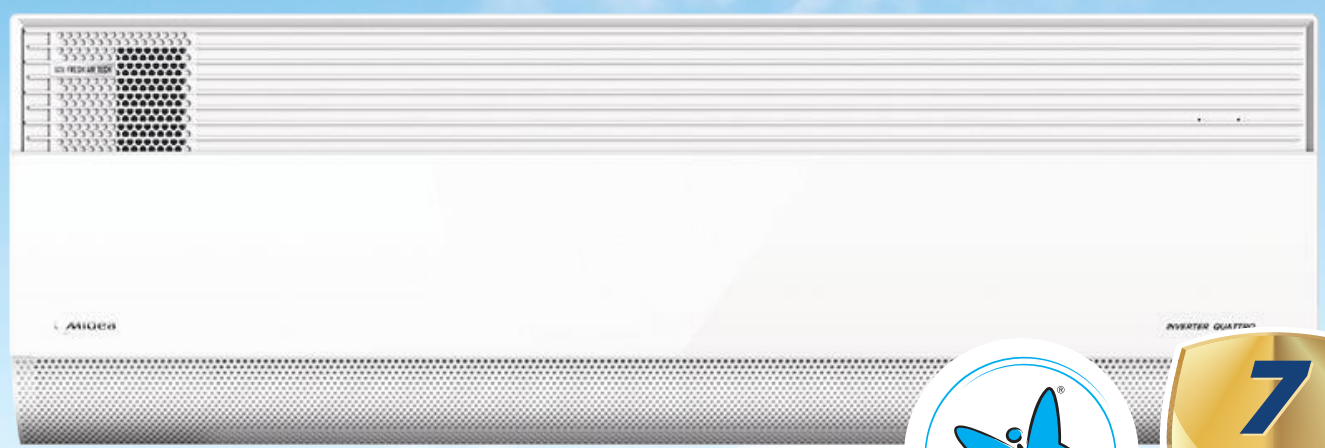
## Cultural change

Removing workforce barriers to entry is much more complex than simply addressing discriminatory language and behaviours. In her presentation, Diana Burgess from Lendlease will speak about the Construction Industry Culture Taskforce, which is working on a culture standard for the sector that addresses inclusion and diversity.

We'll then enjoy three mini-presentations from Megan Dinsdale-Jones, Madeleine Moratti, and Liza Stokes, who will focus on the power of storytelling for building visibility and influencing change.

Tickets are now available, so make sure you secure your spot at this exciting new event!

Alison Scotland



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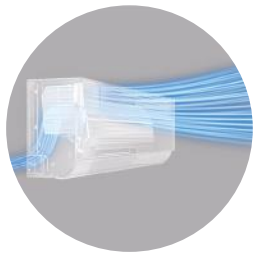

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*The test conducted at Intertek Testing Services Shenzhen Ltd., in 30.0m³/h air flow with DEHS Aerosol, report No. 230504050GZU-001. **The data is tested by Midea Laboratory, and based on the maximal fresh air volume 60m³/h with the room size of 20 square metres and 3 metres high. The product is equipped with 30m³/h fresh air as standard, while the maximum air flow can reach to 60m³/h if the hole is enlarged and the chamber is expanded in A/C installation. ***Self-cleaning mode reduces coil-trapped bacteria by 99.9% after 2 cleaning cycles, tested by UL Solutions (No. A802784). Visit http://verify.ul.com for further details.

OPINION

# It's time to modernise cooling expectations – **and the code that shapes them**

MyPlace Group General Manager Darren Bee calls for changes to the National Construction Code, including making multi-zoning (more than two) cooling/heating systems compulsory in new builds.

It's 2025, and air conditioning remains a key flashpoint in Australia's energy debate. Households are being urged to curb their usage, with policymakers proposing quick fixes such as encouraging people to:

- Turn off the air conditioner
- Stop the dishwasher
- Allow government intervention to control appliance use.

These measures are reactive at best. Worse than that, they ignore the deeper inefficiencies built into the way many Australian homes are designed.

## Necessity, not luxury

In hotter parts of the country, simply switching off the air conditioner isn't just inconvenient – it's unsafe. Vulnerable Australians can't be left to endure extreme temperatures. Nor should they have to.

If we're serious about reducing household energy demand, we need to stop treating consumption as purely a behavioural issue and start addressing the built environment – beginning with the National Construction Code (NCC).

While current NCC requirements call for at least two zone systems in new builds, this is no longer fit for purpose. Two zones still mean entire sections of a home may be cooled or heated unnecessarily, wasting energy and money. A smarter approach is clear: mandate multi-zone air conditioning systems for all new builds.

## In the zone

Multi-zoning allows households to cool or heat only the rooms in use, significantly reducing load on the grid while lowering energy bills. It's the equivalent of running a Hyundai engine rather than a Dodge Ram: more efficient, more economical, and more aligned with contemporary living.

Historically, builders have viewed multi-zoning systems as too complex or costly, but market expectations are shifting. Reports by Domain show the demand of energy-efficient homes continues to rise and climate-resilient design is increasingly influencing buyer decisions. With air conditioning still under policy scrutiny, energy-efficient technology will be a non-negotiable for future-ready housing.

## Better together

This year's formation of the Consumer Energy Tech Alliance (CETA) by the Tech Council of Australia underscores this shift. Industry players are collaborating to get better technology into homes and there is a vital role for the construction industry to play.

Now is the time for the industry and regulators to work together. Updating the NCC to reflect contemporary needs is a tangible, forward-focused step, and one that MyPlace and CETA will formally propose to the Australian Building Codes Board (ABCB) in due couse. Incentivising builders to deliver higher-efficiency homes would further accelerate progress.

Turning off the air conditioning isn't a long-term solution. Smarter regulation, better technology and thoughtful building practices are. For a more energy-efficient Australia, it's time to build better, not just ask households to do better.

## Changing the NCC

The Australian Building Codes Board (ABCB) coordinates updates to the National Construction Code (NCC), taking into account industry research and trends, public feedback, and ministerial policy direction.

The ABCB only considers submissions made using the formal "proposal for change (PFC)" template. You can submit a PFC at any time through the ABCB website, available via the QR code.


## About the author

For 25 years, **Darren Bee** has been a key part of growth of Australian smart air conditioning technology manufacturer MyPlace (formerly Advantage Air), which designs technology that aims to increase comfort and reduce electricity bills. Darren focuses on building relationships within the industry that lead to strong commercial outcomes. He is passionate about Australian manufacturing and committed to advocating for innovative solutions that deliver better cost and energy efficiencies for everyday Australians.

HVAC&R SKILLS WORKSHOP

# Testing and commissioning smoke control systems

**MODULE 165**



## WHAT'S IT ABOUT?

This skills workshop discusses the testing and commissioning requirements for smoke control systems.

## WHO'S IT FOR?

Relevant for technicians involved in installing, commissioning, testing and maintaining fire and smoke control systems in buildings.


This skills workshop, taken from AIRAH's *DA05 – Guide to fire and smoke control in buildings using AS 1668 Part 1*, provides technicians with guidelines for testing and commissioning fire and smoke control systems in buildings. It includes useful templates of record sheets, which technicians can use to keep track of test results.

## Foreword

This section discusses the testing and commissioning requirements for a smoke control system. Designers and installers need to be able to:

- Specify the testing and commissioning procedures necessary for demonstrating that a smoke control system complies with AS 1668.1
- Describe the documentation required by the regulatory authority
- Outline the commissioning procedures and requirements for smoke control systems.

The key points covered in this section are:

- Every smoke control system, complex or otherwise, must be commissioned to demonstrate and verify that it works.
- Commissioning is the job of proving component and system functionality
- Clauses 4.14 and 4.15 of AS 1668.1-2015 require Component Testing and Systems Interface Testing, together with certified test records.

*Note:* AIRAH's *DA27 – Building Commissioning* provides a comprehensive overview and technical detail of the building commissioning process.

## Introduction to testing

Every smoke control system, complex or otherwise must be commissioned to demonstrate that it works.

AS 1668.1 Clauses 4.16, 4.17, 4.18 and 4.19 require Component Testing and System Integrity Testing, together with certified test records.

Appendix E sets out procedures for testing and commissioning of the components, sub-systems and the complete systems, to ensure that they operate as intended during fire alarm.

Detailed test record sheets are provided in the standard to assist in achieving complete documentation for permanent records.

## AS 1668.1 Clause 4.16 – Testing smoke control systems

Component testing refers to the individual performance of actual equipment to deliver its design function. e.g.: this may be a fan or a damper (see Figure 1).

System integrity testing refers to both "sub system" and total system performance to deliver its design function. For example, a sub system will include the component (previously tested) operating within a system such as the passage of air through ductwork.

For a total system, this will include the component and sub system (previously tested) being activated from an alarm signal and its effect overall within the building smoke zone considered for control.

Measurement requirements for testing and commissioning are identified for each type of system to be installed, to ensure that it will function as intended during a fire.

Test schedules should be prepared with all commissioning results recorded and certified.

Reference should be made to Appendix E for specifics of the test procedures.

**Anemometer**

**Magnahelic pressure gauge**

**Figure 1 – Testing smoke control systems – flow and pressure differential**

## AS 1668.1 Appendix E – Commissioning tests

Smoke control systems, complex or simple, depend on every element operating correctly and in the right sequence. Unless every possible function of the smoke control system has been demonstrated to work correctly, then there is a real possibility that the system will not work when required to perform during fire alarm. Commissioning is the job of proving system functionality.

When everything is functioning correctly (i.e., the plant is commissioned) it can be tested to demonstrate that it meets the performance criteria of the standard. After all, it is not much use having a fully functioning stair pressurisation system that starts on fire alarm, operates correctly on smoke detection and fire fan control panel override, etc., but can't achieve the airflow velocity to prevent smoke entering the stairs!

After the fully functioning and commissioned system has been tested to show that it achieves the performance criteria, the results of all commissioning and performance tests must be recorded so that:

- The owner and the authorities know that the system works correctly
- There are performance benchmarks for the maintenance contractor to match
- There is a document, that we hope won't be needed, to produce in court to say the system did work correctly when installed.

The purpose of Appendix E is to provide detailed guidance for the practitioner who is carrying out the commissioning, testing and recording requirements of Clauses 4.14 and 4.15. It is a very comprehensive guide, which should be the basis of all technicians' training in smoke control system commissioning.

## Why commission?

One of the unfortunate aspects of smoke control system installations is that they are usually installed by air conditioning contractors who do not have a background in fire protection. These contractors are often experienced in producing very high-quality air conditioning installations, with a high standard of response to customer concerns after installation. Air conditioning systems generate customer complaints if they don't work perfectly, but fire safety systems that don't work perfectly may not leave any customers at all!

If you have any doubts about the need for extremely thorough commissioning, testing and recording, the following questions should be asked:

- What might not work correctly on the day after installation, before commissioning?
- Does it really matter if it is only 99% right?

### What might not work correctly?

- Motor fuses may not be installed
- Motors may be rotating backwards
- Dampers may be opening instead of closing
- Holes in plenum chambers may prevent design airflow being achieved
- Holes in fire rated walls or ducts may breach the integrity of a fire-resistant barrier
- Smoke detectors may be activating fans rather than shutting them down
- Fire dampers may be installed upside down or sideways
- TPS cable may have been used to power a motor that must operate in fire mode
- The PLC in the fire fan control panel may be wrongly programmed
- The smoke exhaust fan may have been selected for normal duty, not 200°C
- The smoke exhaust fan, selected for 200°C, may overload with ambient air at 20°C.

Job No.:..... Exit No.:..... Sheet No.:.....
Project:..... Fan No.:.....
Address:..... Inspected by:..... Date:.....
..... Approved by:..... Date:.....

| Door location | | Average velocity across door m/s | Door closes and latches correctly | Door opening force N | Maximum noise level stair dB(A) | Maximum noise level occupied space dB(A) | Pressure restoration time s | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| Level | No. | | | | | | | |
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**Figure 2 – Typical system performance record for fire isolated exit pressurisation installation tests**
(reproduced from Appendix E AS 1668.1-2015)

## Does it matter if it is only 99% right?

In a building of 25 storeys, with a zone pressurisation system operating on two supply risers and two return/smoke exhaust risers:

- There are at least 100 air control dampers operating in fire mode
- There are at least 100 damper motors operating in fire mode
- There are about 200 smoke detectors, zoned according to each compartment.

99% right would leave us with perhaps:

- One wrongly stroked damper blade that opened instead of closing
- One damper motor that did not operate on alarm signal
- Two smoke detectors connected to the wrong zone.

This 99% scenario could leave us with a building in which the zone pressurisation system might pressurise the fire-affected floor and potentially exhaust a non-fire-affected floor.

This would lead to the potentially disastrous situation of transferring smoke rapidly from the fire compartment to another compartment, where perhaps this time the system would respond correctly, with further failure!

## Philosophy of commissioning fire safety systems

Appendix E of AS 1668.1 should be read and understood by all smoke control practitioners.

While not in any way a substitute for Appendix E, the following steps provide a short checklist for all smoke control commissioning and testing.

- ❑ Prepare a test schedule outlining procedures and all operating sequences
- ❑ Test each component
- ❑ Test each sub system
- ❑ Complete all building work
- ❑ Complete all work on associated building services
- ❑ Complete all installation work on all components of the smoke control system
- ❑ Test each smoke control system, with smoke to activate the detectors
- ❑ Test the smoke control system's response to smoke detection in every single zone
- ❑ Measure required airflow rates and pressure differentials for all fire zone combinations
- ❑ Measure all required noise levels
- ❑ Record all results, so that they can be easily reviewed and retested in the future.

Figures 2 to 5 show typical record sheets for individual smoke control system and component commissioning.

Job No.: ..... Sheet No.: ..... Date: .....
Project: ..... Inspected by: ..... Date: .....
Address: ..... Approved by: .....

| Exit No. | Fan No. | Normally off | Runs on fire trip | Stops with smoke in airstream | Auto reset when smoke cleared | FDCIE override operates | Cabling and fire resistance correct | COMMENTS |
|---|---|---|---|---|---|---|---|---|
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**Figure 3 – Typical system quality record for fire isolated exit pressurisation systems**
(reproduced from Appendix E AS 1668.1-2015)

Job No.: ..... Sheet No.: ..... Date: .....
Project: ..... Inspected by: ..... Date: .....
Address: ..... Approved by: .....

| AHU No., Fan No. or zone dampers | Name of system area served location etc. | Airflow rate L/s | | Operation with fire in zone | | Operation during general fire alarm (outside zone) | | Manual control from FFCP | | | Indication at FDCIE | | Fitted with supply air detector | | Fitted with return air detector | | Comments* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Design reqt | Tested value | Design reqt | Tested value | Design reqt | Tested value | Design reqt | Tested On | Tested Off | Design reqt | Test result | Design reqt | Tested with smoke | Design reqt | Tested with smoke | |
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**Figure 4 – Typical inspection record for smoke control system installation tests**
(reproduced from Appendix E AS 1668.1-2015)

Building Name: | Mechanical services Inspected by: | Sheet No:
Address: | Fire system Inspected by: | Date of Inspection:
Approved by: | Date of Approval:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanical Services Plant Reference (Fan or damper No.) | Location of Zone Serviced | Fire Control Reference | Design Comments | Automatic Operation Normal Mode | | Automatic Operation Fire in the Zone | | | Automatic Operation Fire outside Zone | | | Manual Control from FFCP | | | Indication FFCP | | | | | Comments on TestsS |
| | | | | Design function | Actual Function | Design Function | Activating Device Note (c) | Actual Function | Design Function | Activating Device Note (c) | Actual Function | Design | Tested On | Tested Off | Design | Tested (Note 1) On | Tested (Note 1) Off | Tested (Note 1) Fault | Performance Test (Note d)) | |
| Smoke Exhaust Fan #1 (SEF 1) | Central Mall (West) | AZF #1 (West Zone) | Runs on smoke alarm in Central Mall West Zone only. | Stop | | Run | | | Stop | | | Yes | | | Yes | | | | | (Indicate here where results of performance tests are available) |
| | | Spr #3 | Runs on Mall Sprinkler alarm. | Stop | | Run | | | Stop | | | Yes | | | Yes | | | | | |
| Smoke Exhaust Fan #2 (SEF 2) | Central Mall (East) | AZF #2 (East Zone) | Runs on smoke alarm in Central Mall East Zone only. | Stop | | Run | | | Stop | | | Yes | | | Yes | | | | | (Indicate here where results of performance tests are available) |
| | | Spr #3 | Runs on Mall Sprinkler alarm. | Stop | | Run | | | Stop | | | Yes | | | Yes | | | | | |
| Relief Air Damper #1 (RAD 1) | Smith St. Entrance (Central Mall) | AZF 1, 2 (Central Mall) | Opens on any smoke alarm in Central Mall. | Closed | | Open | | | Closed | | | No | | | No | | | | | |
| | | Sprinkler Pressure Sw. | Opens on Mall Sprinkler alarm. | Closed | | Open | | | Closed | | | No | | | No | | | | | |
| Relief Louvres (RL 2) | Jones St. Entrance | N/A | Make-up for Smoke Exhaust fans. Must be free of rubbish. | | | | | | | | | | | | | | | | | (Indicate here if louvres were free of leaves, rubbish or other risk of blockages) |
| Air Handling Unit No. 1 (AHU 1) | Central Mall (West) | AZF #1 (West Zone) | Stops on smoke alarm in Central Mall West Zone only. | Run | | Stop | | | Run | | | Yes | | | Yes | | | | | |
| | | Sprinkler Pressure Sw. | Stops on any Sprinkler alarm. | N/A | | Stop | | | N/A | | | Yes | | | Yes | | | | | |
| | | AHU #1 Supply Air | Stops on smoke detection in Supply Air. | N/A | | Stop | | | N/A | | | Yes | | | Yes | | | | | (Indicate here if AHU No. 1 Fan stopped on Supply Air smoke detection) |
| Kitchen Exhaust Fan # 4 (KEF4) | Joe's Cafe (Eatery) | AZF #5 (Eatery) | Stops on smoke alarm in Eatery Zone only. | Run | | Stop | | | Run | | | No | | | No | | | | | |
| | | Sprinkler Pressure Sw. | Stops on any Sprinkler alarm. | Run | | Stop | | | N/A | | | No | | | No | | | | | |
| Toilet Exh. (TEF5) | Eatery | GFA | Stops on any Fire alarm. | Run | | Stop | | | N/A | | | No | | | No | | | | | |
| Fresh Air (QAF 2) | Fashion | GFA | Stops on any Fire alarm. | Run | | Stop | | | N/A | | | No | | | No | | | | | |

**Figure 5 – Smoke control system Functionality Test Chart**
**(to be read in conjunction with Clause I5 of AS 1851-2012)**
(reproduced from Appendix E AS 1668.1-2015)

This month's skills workshop is taken from AIRAH's *DA05 – Guide to fire and smoke control in buildings using AS 1668 Part 1.*

# From **fridgie** to **footy**

Until May 27, 2025, Mani Liddy was a fridgie working for O'Connors in South Australia. The next day, he became an AFL footballer.

**Nick Johns-Wickberg**
EDITOR
nick.johnsw@airah.org.au

Photo by Brooke Bowering


Mani Liddy celebrating a victory with Aliir Aliir

Photo by Matt Sampson

Most people would be ecstatic to realise their childhood dream, especially when it hasn't come easily. But when Port Adelaide called Mani Liddy's name out in the 2025 AFL mid-season draft, he didn't take long to soak it in before getting back to business.

"It was a bit of a relief for half a day," Liddy says of his reaction to being drafted. "But I'm a realist and this was the next step in my journey, so it was straight back to work – I didn't really celebrate it that much.

"I just want to work as hard as I can and get the most out of the opportunity."

## Putting in the extra shift

Working hard is nothing new to Liddy. In the five years before he was drafted, he worked up to six days per week as a refrigeration and air conditioning technician, while also moonlighting as a professional footballer for Sturt and then Central District in the SANFL, one level below the AFL.

"We'd leave home anywhere between 5.30am and 7am in the morning, and I often wouldn't get home until 9pm," Liddy says.

"I'd go to work from 7am to 4pm, then it was straight to training from 5 to 8pm. That was three times a week, then on my days off I'd have to do weights sessions as well, then I'd play on the weekends. They were long days.

"You don't have a lot of time to do any meal prep or cooking, so I was lucky to have really good support from my family. My mum and sisters always made a little bit extra for me, which was nice."

And while being an AFL player comes with its own set of physical and psychological demands, Liddy says his work as a fridgie has given him some important perspective on his new career.

"I definitely think having to go out and earn your money by working a 'real' job has set me up really well," Liddy says. "You don't take for granted the amount of hours you put in at a normal job compared to AFL.

"Being an AFL player is definitely not laid back, but you don't have those taxing physical days before you have to go to training or games. So I definitely appreciate the lifestyle."

## Right fit, right time

Becoming a fridgie wasn't necessarily part of Liddy's plan, but it wasn't an accident, either. The goal was always to become an AFL footballer, but despite captaining South Australia at underage level, he was overlooked in his draft year.

Not one to let disappointment get the best of him, Liddy took stock of his options and decided to find a job he loved doing, while also striving to improve as a footballer.

"Straight out of school I knew I didn't want to go to uni, so I hunted around and did a bit of work experience," he says.

"I did some carpentry and tiling when I was at school, and after I finished I went and did a bit of trades assistant work with some diesel mechanics, working on cranes and trucks and cars. I didn't really like that because you're in a warehouse all day and I prefer to move around."

Liddy wanted a job that was varied, challenging, and gave him the opportunity to go to new places and see new things. That's when refrigeration came calling.

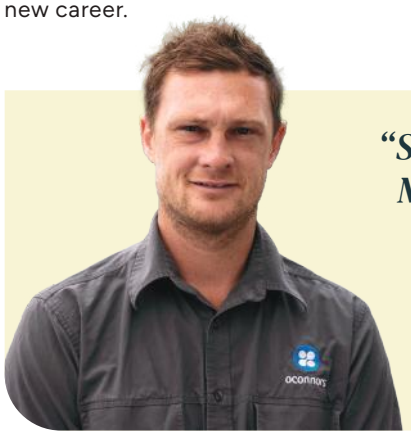
"My uncle was the service manager at O'Connors, and he suggested that I come and do some work experience," Liddy says. "A week was enough for me to be content with refrigeration as my trade."

## Ticking all the boxes

They say variety is the spice of life, and Liddy certainly got to experience this during his five years as a fridgie.

In his first few years, he got to work on exciting projects at interesting locations, including university campuses and defence facilities. The latter opened Liddy's eyes to how tough refrigeration could be, especially when it's cold and you're working outside.

"I was out there when I was a second-year apprentice," he says. "That was a 'welcome to the trade moment' – it was the middle of winter and I was doing first-year jobs like painting and cutting, so it wasn't the best."



*"Since starting as a first-year apprentice, Mani has shown incredible growth, both personally and professionally. This has shown in his career progression and also his football.."*

**Russell Clayton, O'Connors**

However, as Liddy evolved as a technician, so did the kind of work he got given.

"As I got into my third and fourth year I moved into the city and started doing service work on high rises, which is what I was doing when I got drafted," Liddy says.

No matter what tasks he was responsible for on any given day, he found the job challenging and satisfying in equal measure.

"Most days were pretty hard," he says. "Winter is a bit quieter, but summers were flat out.

"There was also some weekend work. We used to do fire testing, so that was always available on Saturdays or after hours."

## Team-first philosophy

Russell Clayton was Liddy's supervisor during his time at O'Connors. Clayton looks back fondly on Liddy's development, both at work and on the footy field.

"Mani is a quiet yet quirky individual who brings a unique humour to the team," Clayton says. "Since starting as a first-year apprentice, Mani has shown incredible growth, both personally and professionally. This has shown in his career progression and also his football."

He also identifies several qualities in Liddy that any AFL coach would surely be happy to add to their team.

"Throughout his time at O'Connors, Mani consistently demonstrated a strong work ethic and a genuine eagerness to learn," Clayton says. "He was always there to assist when required.

"He is always very easy-going, fun, and has relaxed attitude to life – he's been a great mate inside and outside of work!"

Photo by Matt Sampson

And while it's always tough to lose a valued team member, Clayton and his colleagues couldn't be happier for Liddy to be living out his childhood dream.

"It was a bit surreal really as it all happened so quick," Clayton says. "One minute he was doing normal day-to-day work. and the next he was gone!

"Obviously everyone who knew and worked alongside Mani were all super excited, and there definitely was a bit of a buzz going around the company when it got announced. We are all proud of him and wish him all the best in this next chapter with Port Adelaide."

Refrigeration, like footy, is a team game, and Liddy was thankful not to leave his colleagues in the lurch when he got drafted.

"At the time they had an extra technician floating around and they could cover my work quite comfortably!"

## Transferrable skills

You might not think that refrigeration and footy have much in common, but Liddy says he learnt plenty during his time as a fridgie that extends well beyond the trade.

"Being a fridge tech in service, you build a lot of people skills – you have to deal with customers every day," Liddy says. "I don't think people realise the life skills you get out of it. I learnt so much in refrigeration – not just the actual trade skills, but doing my own quoting and seeing how things work in real life."

Clayton agrees, highlighting the development in maturity he saw as Liddy grew into his work as a fridgie.

"The skills Mani has developed on the job – both technical and personal – will absolutely support him in his footy career," Clayton says. "I think working in the HVAC industry would have provided him great life skills with being accountable and performing under pressure, especially during the summer period – as any fridgie would know.

"I think having that time to learn a trade and having that extra time to personally mature holds him in good stead for his football career. He will enjoy every minute, make the most of it and not take any second of it for granted!"


Photo by Matt Sampson

Liddy is particularly grateful for is the independence he got on the job, and the trust Clayton was willing to put in him from a young age.

"At O'Connors, we ran our own show – we did our own quoting and were responsible for keeping our customers up to date with what was happening in their buildings – so it has really helped with my people skills.

"My supervisor threw me in the deep end when I was a second-year, and that helped me a lot in the trade," he says.

And while he always felt supported, he was encouraged to learn as much as possible and to trust his own judgment.

"He let me go look at jobs on my own," Liddy says. "He told me to call him if I needed to, but to try and figure it out on my own if possible.

"I got to talk to customers on my own when I was 18 or 19, which really helped build my self-confidence."

Now playing at the highest level in a sport where self-confidence is key to performance, Liddy's years in the trade are paying dividends.

## The pursuit of happiness

Life after sport can be tough. Elite athletes who have the world at their feet can lose it all through one injury. Many find their career over by their early 20s, and even those who succeed rarely make it beyond their early 30s. Without any work experience outside their sport, many struggle to readjust to the real world.

Liddy is rightfully focusing on the present and making the most of his opportunity as an AFL player. But he realises that his experience as a fridgie will help him land on his feet if the worst comes to the worst, and it's a great career to return to down the track.

"I obviously want to play as long as I can – that'll come down to how I look after my body and making sure I train the right way," he says. "It's nice to have something I can fall back on, but I'm hoping that's not for another eight to 10 years!"

Liddy would encourage those who want an active and challenging career to consider a trade. He'd also encourage them not to rush their decision and make sure they find the trade that works for them.

"I think it's good to try multiple trades," Liddy says. "That's what I did, and it helped me get a feel for it. It might cost you a week or two worth of pay, but at the end of the day you get to experience something new, and you'll be able to find something that makes you happy.

"Being a chippie or a tiler didn't really make me happy – it was a bit repetitive – whereas being a fridgie you get a mix up every day, which I really liked."

And while life as a fridgie might not provide quite as much happiness as being a professional footballer, it's a pretty close second for Mani Liddy.

## What's a fridgie?

**Almost overnight, Mani Liddy has become arguably Australia's most recognisable refrigeration technician. So what did his new Port Adelaide teammates know about his former life as a fridgie?**

**Not much, as it turns out.**

**"I had to explain it to them a little bit," Liddy says. "A few of them had half an idea of what I used to do, but most of them didn't.**

**"A few of them asked whether I fixed fridges. I barely touched fridges!"**


The Port Adelaide team song after Liddy's first victory

Photo by Matt Sampson

# **Strength** in adversity

Somewhat ironically, Liddy's darkest hour led to the eventual realisation of his AFL dream. It also ensured he'd be a cult figure from the moment he set foot on the field.

The injury came towards the back end of the 2024 season. It seemed completely innocuous – just a scratch to the side of the knee after tackling an opponent that drew a bit of blood. The medics cleaned and stitched up the wound, and Liddy played out the match.

But it was a wet and muddy day, and the wound had become infected. Standard antibiotics didn't do the job – Liddy could barely walk on the Monday, and by the Tuesday he couldn't put any weight on the leg at all.

When he went to hospital on the Wednesday, the infection had spread all the way up to his groin; he required two emergency surgeries to fully flush the infection out. He didn't realise it at the time, but if Liddy had waited one more day to go to hospital, his leg would likely have been amputated.

The injury caused him to miss five games of footy, and it also left him unable to do his normal fridgie work while he was recovering.

"After I had the surgeries, I had to keep my leg straight for 10 days, so I missed just under two weeks of work," Liddy says. "After I got the stitches out I came back on light duties for a week or two, because I couldn't bend my knee or kneel.

"I guess those are the consequences of playing footy part-time and having to work full-time," he adds with a laugh.

Nowadays, Liddy wears a black compression "sleeve" on his right leg to stop the weaker skin on his knee from bleeding during matches. Of the more than 10,000 people to play in the AFL over 130 years, he's the first to sport this unique look.

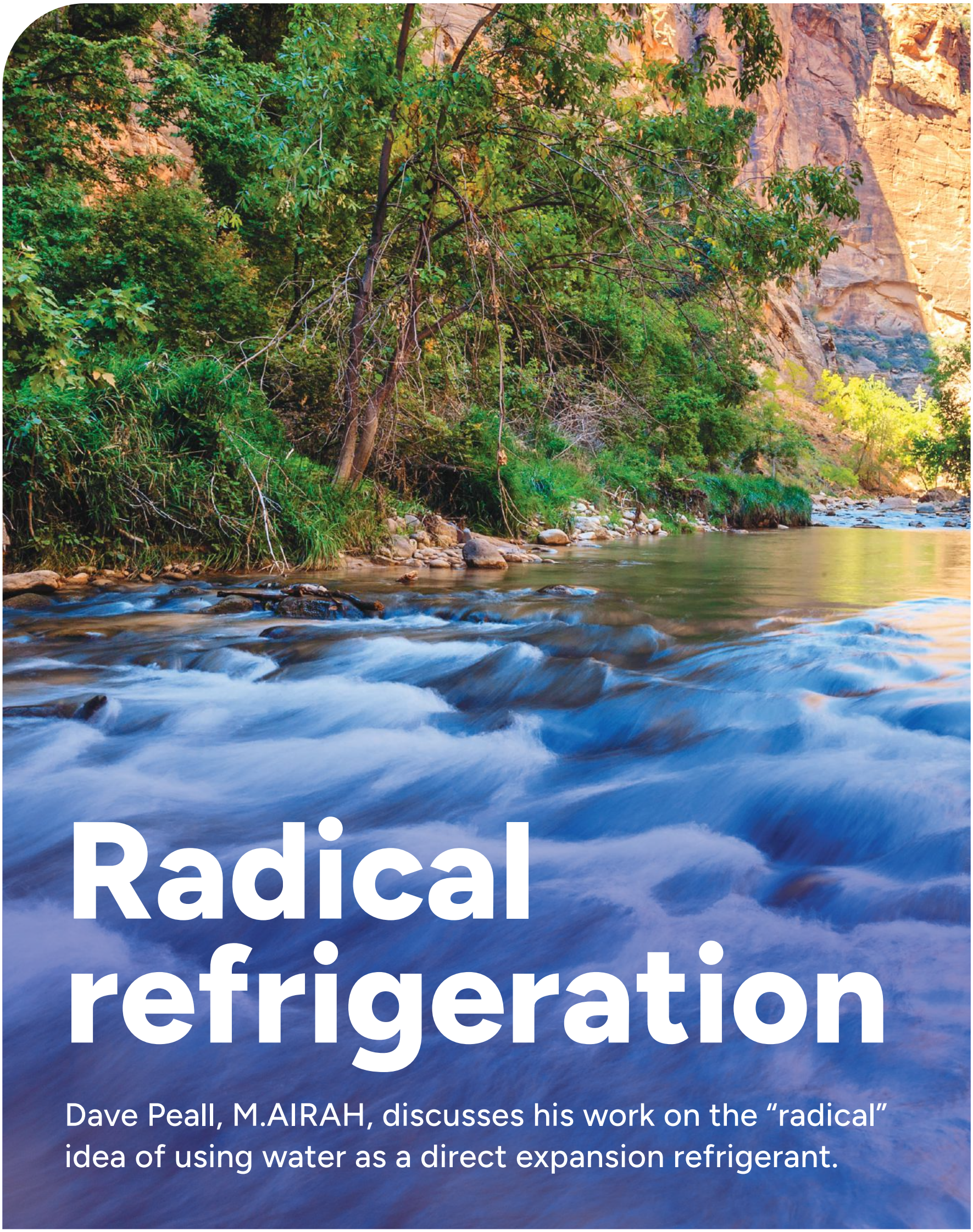
But Liddy is proving to be much more than just a cult hero. The injury helped spur Liddy to improve his diet and fitness, which took his game to the next level and ultimately led to him getting drafted.

Port Adelaide's new number 50 has quickly established himself in a midfield headlined by stars like Zak Butters, Jason-Horne Francis, Connor Rozee, and Willem Drew.

"Mani has continued to develop his game over the past few seasons after he made the move to Central Districts from Sturt," says Port Adelaide National Recruiting Manager Geoff Parker.

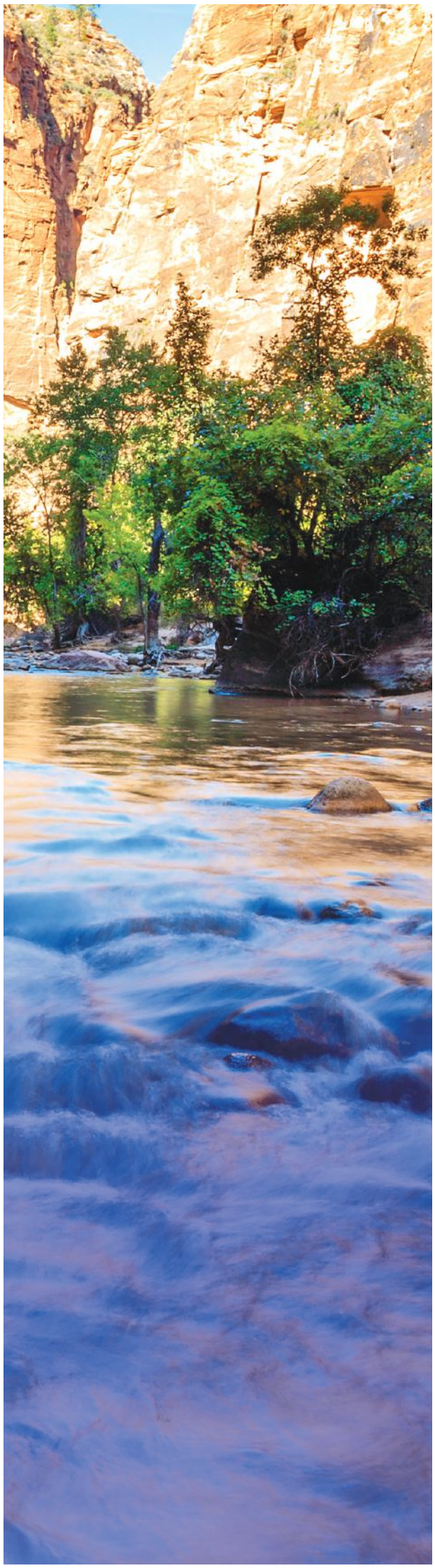
"This year, he has become a damaging midfielder who anticipates quickly to get into a position to receive. He is very clean below his knees and has shown that he can win the ball in the contest and has the endurance to work up and down the ground."

Liddy and Mitch Georgiades at training
Photo by Matt Sampson



# Radical refrigeration

Dave Peall, M.AIRAH, discusses his work on the “radical” idea of using water as a direct expansion refrigerant.



Once upon a time, in a land far, far away from my Rockhampton apprenticeship, I was enjoying one of my career diversions as chief engineer of the Cambridge Holiday Inn. Based more on idle curiosity than a career-defining ambition, I boarded an evening train to London. My destination? The Institute of Refrigeration.

That night's lecture raised a fascinating question: Could water be used as a direct expansion refrigerant (DX) in a vapour compression system?

The lecturer concluded that water was cheap and readily available, but its benefits as a refrigerant were outweighed by practical limitations; conventional machinery and ancillary components could not easily be adapted for use with water. At the time, the HVAC&R industry was besotted with the new R134a gas, which wasn't inordinately expensive and didn't require reskilling by refrigeration technicians. From the presenter's point of view, water wasn't really a viable option.

One brave soul asked whether it would be possible to air condition a house using water as a DX refrigerant, as opposed to the status quo approach of using wall-mounted splits or evaporative coolers. I remember the presenter peering over his glasses at the inquisitor before delivering his pessimistic conclusion: it was technically possible, but one would need a compressor the size of the house to handle the volume of suction vapour.

While I was fascinated by this discussion, its true relevance only dawned on me decades later.

## Direct expansion refrigeration: the theory

Before picking apart that lecturer's conclusions, let's take a look at some of the relevant principles of refrigeration.

Lowering the temperature of a substance – whether it be fish or a computer chip – involves removing and transferring heat. Modern refrigeration and air conditioning is based on theorising and experimentation going back centuries. As can be seen in Figure 1, a compressor is the mechanical heart of a vapour compression system, with in-line piping connecting to two heat exchangers.

Starting at the top, a throttling device controls liquid refrigerant flow to the evaporator, where it boils by absorbing heat from its surroundings.

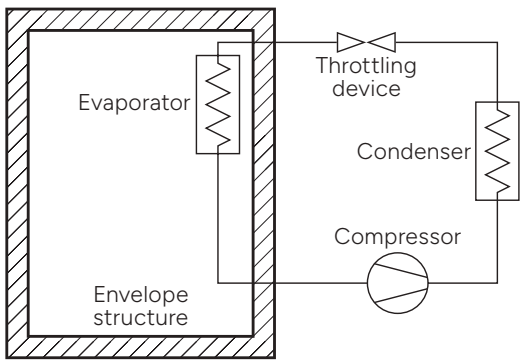



Figure 1

The heated, low-pressure vapour is drawn back to the compressor, where it is transformed according to Charles's Law and Boyle's Law.

As the gas is compacted to a higher pressure – and a correspondingly higher temperature – it flows into the appropriately named condenser. Heat that was removed in the evaporator is rejected to air flowing over the condenser, thereby converting the gas to a high-pressure liquid.

Based on cooling requirements, liquid refrigerant is supplied to the evaporator by the throttling device. The refrigerant is then back where it started in the hamster wheel cycle. In a properly designed and manufactured system, this process can continue perpetually, as long as the compressor keeps pumping and the gas doesn't escape.

Apart from substituting two pumps with a compressor, the technical requirements of a vapour compression system haven't really changed since Jacob Perkins patented his invention in 1834.

With this in mind, I'm currently undertaking a Master of Philosophy [Mechanical Engineering] at the University of Wollongong, having worked for five decades as a refrigeration technician. I aim to disrupt conventional thinking and redesign <30kWr (kilowatt of refrigeration) domestic and light commercial air conditioning and water heating using $H_2O$ as a DX refrigerant. My goal is to use this technology to reduce operational costs and minimise environmental impact.

## $H_2O$'s properties as a refrigerant

Now let's look at why water is worth considering as a DX refrigerant and the challenges we'd need to overcome to make this possible.

### Upsides

Water has plenty going for it as a refrigerant. Here are some of the positives:

**Refrigerating power:** Water is one of nature's most powerful refrigerants and has been used in this role for thousands of years, so much so that it even has an ASHRAE-designated identification number: R718. Thanks to its high latent heat of evaporation of 2,501kJ/kg at 0°C, water in DX mode has a staggeringly effective propensity to absorb heat. The comparative phase change latent heat of evaporation of HFO-1234yf is a mere, but industry-accepted capability of 164kJ/kg at 0°C.

**Safe to handle:** Water is intrinsically safe, non-toxic, non-flammable and non-explosive. Unlike all chemical refrigerants and other naturals – including $CO_2$ and ammonia – water is inestimably unlikely to cause oxygen depletion and suffocation when accidentally released into an occupied space.

**Eco-friendly:** $H_2O$ is 99.9% environmentally friendly as it has negligible ozone depletion potential (ODP) and zero global warming potential (GWP). It is readily available and cheap, even in if required in a distilled or demineralised form.

**Adaptable:** Water can be adapted for low temperature use by adding glycol or graphene. In a pinch – such as in remote areas – hand cleaning gel or methylated spirits could work.

**Low-pressure operation:** Water safely operates at pressures far lower than those encountered with all other commonly used refrigerants. $H_2O$ heat exchangers would be considerably smaller and could conceivably include injection moulded polymers, which have greater conductivity than stainless steel.

## Downsides

If you ponder the psychrometric characteristics of water being married to traditional vapour compression mechanics, it seems foolhardy to combine the two and expect water to behave in a similar fashion to other commonly used refrigerants. Here are some reasons why:

**Vacuum requirement:** Water's psychometric chart tells us that the evaporator must operate at a vacuum, which presents challenges – after all, nature always strives to occupy negative spaces. This traditionally leads to the ingress of air, which quickly becomes a non-condensable, non-desirable intruder.

**Heat capacity:** The sensible heat capacity of water vapour is very low; this requires large volume flows, which then demand relatively high compression ratios so the vapour can condense back into a liquid. Compared with classical refrigerants like R134a or R290, water requires approximately 200 times the volume flow, and about double the compression ratio for similar applications.

**Insulation problems:** Traditional sealed or semi-sealed compressors have exposed, single-insulated electric motor windings. Water can cause this insulation to decompose, leading to catastrophic burnout.

**Oil and water:** Rotating compressors rely on oil to lubricate moving parts. Unfortunately, water does not mix well with oil. These issues could be circumvented by using magnetic bearing oil-free compressors, which can operate in excess of 50,000rpm, but are currently only offered for use in systems over 50kWr capacity. An open-drive compressor could be used if the oil–water mix lubrication issue were resolved.

## $H_2O$ as a secondary refrigerant

While $H_2O$ hasn't yet been successfully used as a DX refrigerant for the reasons discussed above, it has a surprisingly long history as a secondary refrigerant.

After developing the first unitary air conditioner in 1902, Willis Carrier progressed to build central plant systems using centrifugal compressors to reduce humidity in textile mills and printing presses. The concept was adopted for multi-storey buildings. Direct expansion and supply of refrigerant to each floor was common practice, but at some stage, water was introduced as a cheaper option as a secondary refrigerant.

Water is still commonly used as a secondary refrigerant in large commercial projects. However, it is gradually being overtaken by VRV/VRF systems circulating large amounts of synthetic refrigerant, including the "mildly flammable" R32.

Using hydrocarbons or ammonia in confined or occupied spaces comes with flammability and toxicity risks. However, these could be mitigated through the use of $H_2O$ in secondary or DX refrigerant roles.

## Resistance to change

In 1834, Oliver Evans colluded with Jacob Perkins to build an experimental volatile-liquid, closed-circuit vapour compression system. In 1851, Australian refrigeration pioneer James Harrison built the first commercially viable ice-making machine using similar principles.

A working replica of James Harrison's ice making machine

# The four generations of refrigerants

In 2008, James Calm segmented refrigerant development into four distinct phases.

**First generation**
**1830–1930s**
**Whatever worked**
R744, R717*, R718, Ethers, $CO_2$, $NH_3$, $SO_2$, $HCOOCH_3$, HCs, $H_2O$, $CCl_4$, CHCs ...
* R717 always dominated large capacity industrial refrigeration

**Second generation**
**1931–1990s**
**Safety and durability**
R12, R600a, R502, R22, R13, R503, R170, R1150, CFCs, HCFCs, HFCs, $NH_3$, $H_2O$ ...

**Third generation**
**1990–2010s**
**Ozone protection**
R134a, R600a, R410A, R407C, R404A, R422D, R23, R508B, R170, R1150, (HCFCs), HFCs, $NH_3$, $H_2O$, HCs, $CO_2$ ...

**Fourth generation**
**2010–ongoing**
**Global warming**
R1234yf, R450A, R600a, R32, R446A, R290, R448A, R454C, R744, R290, R41, R1132a, R170, R1150, zero/low ODP, low GWP, short $\tau_{atm}$, high efficiency

- **First generation refrigerants (1830–1930)** encompassed almost anything that worked, including ether, sulfur dioxide, methyl chloride, ammonia, hydrocarbons and carbon dioxide. Safety concerns raised after explosions involving methyl chloride and hydrocarbons inspired Midgley, Henne and McNary to synthesise the first chlorofluorocarbon (CFC) refrigerant in a GM Research laboratory in 1929.
- **Second generation refrigerants (1931–1990)** included CFCs, HCFCs, $NH_3$ and $CO_2$. Synthetics became the OEM gases of choice, and sales were accelerated by equipment servicing leakage rates up to 80% – a million tons of freon 12 were allegedly manufactured annually. Freon 11, 12, 22 and 502 lost their stranglehold in the mid-'80s, when a hole in the ozone layer was discovered, after the industry had dismissed scientific predictions in the mid-'70s that CFCs would enter the stratosphere where solar radiation would cause the release of highly destructive chlorine atoms.
- **Third generation HFC refrigerants (1990–2010)** were heralded as being less environmentally damaging, until it was discovered they have significant GWP. Many countries have committed to phasing down these refrigerants, or eliminating them entirely, with the move ushering in a necessary revival of natural refrigerants.
- **Fourth generation refrigerants (2010–ongoing)** include natural options such as hydrocarbons, ammonia and $CO_2$. I would argue that water should also be part of this list. Hydrofluoroolefin (HFO) refrigerants – which have universal acceptance by the automotive industry as the only safe replacement for R134a, and are also used in some stationary applications – are also considered fourth generation refrigerants. HFOs have been engineered to fall below designated GWP limits. Unfortunately, they love to bond with atmospheric moisture. With some HFOs being designated as "forever chemicals", their increasing detection in vegetation, ground, sea water and wildlife is causing justifiable international concern.

Nearly two centuries later, the same vapour compression technology is still being used in 80% of global refrigeration and air conditioning. Over half a century of involvement, I have seen that the HVAC&R industry is slow to break away from traditional practices. Indeed, at a conference earlier this year, I saw a company "introduce" a process that was first patented in 1906.

Research shows us that radical, out-of-the-box thinking is a pre-requisite when considering water for use in a vapour compression system. With the environmental impact of refrigerants in the spotlight like never before, I'd argue that now is the time for such thinking.

## Applications of $H_2O$ as a DX refrigerant

Safety issues posed by the unintended release of hydrocarbons and ammonia into occupied or confined spaces can be negated by using water as a DX refrigerant. The potential uses for refrigerant being factory sealed in an externally located casing are almost limitless.

The goal of my university research project is to design and build a heat pump, heat recovery energy hub primarily for use in the <30kWr domestic and light commercial market.

Stackable outdoor units will be designed to use renewable energy and a hybrid hydrocarbon refrigerant. System efficiency will be improved by substantially increasing refrigerant-to-heat exchanger surface contact. Water will be used as a direct expansion rather than a secondary refrigerant using a single compressor cascade configuration. The system will significantly reduce the demands of energy-hungry electric resistance heaters and air conditioning compressors, thereby freeing storage batteries at night to feed power back to the grid.

Much of the theoretical work is done – now I have to concentrate on building and testing a working prototype. To do this, I need to safely collaborate with industry experts who have global manufacturing and distribution capability. There are significant technical hurdles, but perhaps the biggest challenge is bringing about change in what can be a conservative industry. My quest to expand on Jacob Perkins's dream might be reminiscent of Don Quixote's, but it's one I think is worth embarking on.

## Conclusion

If we accept the historical premise that a leak-free HVAC&R vapour compression system will never exist, then chemical refrigerant release will always pose a threat to life, land, water or atmosphere. In my mind, the only sustainable option is to change to natural refrigerants – hydrocarbons, ammonia, carbon dioxide and water – as quickly as possible.

## About the author

After more than half a century as a fridgie, **Dave Peall, M.AIRAH**, is undertaking a Master of Philosophy (Mechanical Engineering) degree at UoW, concentrating on improving air conditioning efficiency and sustainability by using water as a direct expansion refrigerant.

# Competing **at scale**

**Lara Blake from Tenderfy looks at how HVAC&R SMEs can compete – and thrive – against large businesses when it comes to government tendering.**

**Lara Blake**
CONTRIBUTING AUTHOR

Securing government work can be very attractive for small and medium enterprises (SMEs). Winning a government contract can have many long-term benefits such as ongoing work, industry visibility and building trust among future potential customers and clients.

Unfortunately for many SMEs, the government tender process can be overwhelming, time-consuming, and in some instances quite disheartening.

The reality is that small companies rarely have comparable resources to bigger organisations, and the tendering process can often feel like an uneven playing field. Time and time again, large contracts are awarded to equally large organisations who have sizeable bid-writing teams at their disposal.

The Australian government has committed to providing small businesses with more opportunity to secure contracts, and so far has exceeded its small and medium enterprise (SME) procurement target of 35% of contracts by value from SMEs, for contracts with a value of up to $20 million.

This is a huge step in the right direction. So why does it still feel like SMEs are fighting an uphill battle?

The bottom line is that small businesses tend to use their whole team to prepare documents and submit complex tenders – taking away from revenue generating work in the hopes of winning a government contract – while bigger companies have the resources and teams to manage these submissions at scale with ease.

So, what can SMEs in the HVAC&R industry do to ensure they not only compete with these larger players, but actually thrive in the world of government tendering?

## Getting tender-ready

If you've ever submitted an Australian government tender, you'll know the layers of complex documentation you typically need to provide. Having a suite of documentation pre-prepared and readily available will assist in streamlining the tender process.

Recommended documentation includes:

### 1. Company profile and background

Having a strong and compelling company profile along with a polished capability statement that showcases your strengths is a good way to position your business for success. Procurement managers often come from diverse backgrounds – without necessarily any experience in HVAC&R – and rely on clear, jargon-free information to make decisions. There are many resources and webinars available to assist you in preparing a strong capability statement.

### 2. Organisational chart and team résumés

Procurement officers will want to see the team assigned to the project, along with their experience and qualifications. Providing a company organisational chart and company branded résumés provides a strong opportunity to present your team effectively.

### 3. Case studies and evidence of relevant experience

Preparing examples of previous work relevant to the tender is essential. Make sure your project examples are professionally branded, consistently formatted, and clearly demonstrate your ability to deliver on similar scopes of work. Many tenders require at least two examples of projects of a similar size and complexity. You may also be asked to provide referees, so it's a good idea to have their details ready and confirm they're happy to be contacted.

### 4. Insurances

Public liability, professional indemnity, and workers compensation are the standard insurances you'll need to have any chance of winning a government tender. In the HVAC&R industry, you might also need construction works insurance (also known as contracts insurance).

## Hot tips

It's important to ensure all your documentation is prepared with consistent company branding. While this may seem like a minor detail, a cohesive and clean set of documents conveys professionalism and good organisation, making a positive impression from the outset

It's also important to centralise all your key information, such as your suite of documentation listed above. This will save time, ensure consistency, help team members work together efficiently, and reduce duplication across your tenders.

It's important to ensure these insurances meet the minimum coverage requirement. This information can generally be found under the mandatory requirements section in the tender.

### 5. Certifications

ISO certifications such as ISO 9001 are highly regarded and in some cases mandatory, so it's worth conducting some research into whether investing in an ISO accreditation will benefit your business. Trade licenses, certifications, and industry-specific accreditations are also important; ensure they are in date and keep digital copies in your suite of centralised information.

### 6. Policies and procedures

Government agencies will expect you to provide everything from your WHS policy to your business continuity plan. Ensure you have a strong and up-to-date company policy framework addressing all facets of your business operations.

All tenders now require that the vendor meet the ethical supplier threshold and pass the supplier diversity and local benefits test.

## Compliance

Compliance is one of the biggest hurdles in tendering. Even small oversights like missing a tick box or exceeding a word count can result in a non-compliant submission.

It's also critical to address every question in the tender, even if it's not relevant to your business. In those cases, respond with something like: *"This question does not apply to us for the following reasons..."* to show that you've read and acknowledged the requirement.

## Government panels

Do your research on government tendering platforms such as Vendor Panel, Local Buy and Australian Tenders. Panel arrangements open regularly, and while acceptance does not always guarantee work, it does ensure your business is visible and on the correct supplier lists for procurement teams. Ensure you are subscribed to daily notifications advising of upcoming tenders, as well as other state- and territory-specific tendering platforms.

Some tenders provide supplier briefing sessions prior to the tender officially going to market. Ensure you register for these – this is your chance to get first-hand, face-to-face information about the tender and reach the procurement team on a personal level.

## Embrace the tech!

A common pain point in tendering is reworking the same document over and over again. Using tender management software or automation tools can assist in eliminating repetitive tasks, maintaining compliance, and improving your submission quality at scale.

There are now many software solutions readily available, whether it's a simple request for proposal (RFP) response tool that uses AI to

prepare responses, or an all-in-one software as a service (SaaS) platform that allows you to complete the whole tender in one application.

Some AI-powered software tools can read over the tender documents and pull important information that will help you decide whether the tender is the right fit for you. After all, not every tender is worth your time pursuing.

These tools will streamline your process and reduce the time it takes to prepare the tender. Embrace the tech – your competitors certainly are!

## Leveraging partnerships

Leveraging partnerships and maintaining a presence at industry events is a smart move. There are many conferences, roadshows, and networking opportunities where companies can engage directly with government representatives. Staying consistently visible helps build relationships, strengthens your reputation, and can lead to valuable contract opportunities.

## Get a debrief

The chances are you are not going to win your first tender, and this can be disheartening given the amount of time and preparation involved. If you are unsuccessful, you are entitled to a debrief. Always ensure you get this to find out where your weaknesses were and what you could do better next time.

A typical debrief involves a meeting with the procurement officer who sent the tender out. This can be done via phone, email or face to face.

## Final thoughts

Government tendering can feel daunting, but with the right preparation, processes, and tools, HVAC&R SMEs are in a strong position to compete and win. Start small, stay consistent, and don't underestimate the power of a well-prepared bid!

## About the author

**Lara Blake** is the Partnership Development Manager at Tenderfy, a provider of tender management software, where she drives strategic growth, fosters partnerships, and champions digital solutions.
With extensive experience across tech, SaaS, and government sectors, Lara is passionate about simplifying complex processes and helping businesses accomplish more with smart technology.

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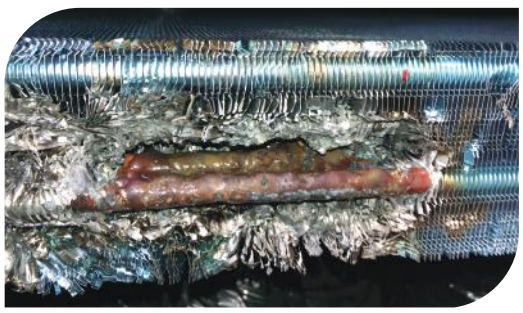

## 1. Straight from your nightmares

"The customer mentioned that they had their evap coil repaired due to a leak five months ago, but the system was underperforming and short on refrigerant again," says Angelo, who was called to deal with this horrific scene that's reminiscent of the film Alien. "As per the photo," he adds, "the coil was still leaking …"

STEVE SAYS

I'm willing to admit that I tried to do exactly the same thing to a chilled water coil back when I was a third-year apprentice … with exactly the same result! Of additional concern to the persistent leak, the fins play an integral part in the heat transfer capacity of a coil. Damage on this scale will severely impact the airflow in this part of the coil, further reducing its capacity.

## 2. How's it hanging?

While at a job site, Harry found this split system that had been lifted by ratchet straps – with a bucket to catch all the water – because the owner wanted to put a walkway beneath it. "We found the unit turned on and working when we arrived," says Harry. Sometimes you really have to suspend your disbelief …

STEVE SAYS

Way back when I was a young tradie, refrigeration was seen as a critical process, while air conditioning was seen as a luxury that many couldn't afford. Today that seems to have reversed. People can't bear the thought of life without an air conditioner! This photo is testament to the resilience of RAC systems.

## 3. Unbe-leave-able

Steve encountered this natural wonder on a service call. "The customer says this system keeps making a weird rattling, scratching noise when in use. When I stripped it down, I found it was full of leaves and small twigs in the condenser fan area," he says, having twigged on to what was happening pretty quickly …

STEVE SAYS

This "window rattler" is clearly bushed! Sorry, had to join in on the puns … Routine maintenance does not seem to carry the import that it did in years past, perhaps perpetuated by the reliability of modern systems. They run almost continuously for many years under all sorts of extremes, relegating them to an area of low prominence in people's minds.

## 4. What's in the box?

Simon and his colleagues were called in to relocate this enclosure, which contains a mini chiller for direct cooling of medical equipment at a hospital. "Clearly there must have been some performance issues, because someone has installed a window rattler to air condition the enclosure that contains the chiller," he says. Amazingly, the system was still working, although the client agreed it was time for an upgrade.

STEVE SAYS

It's not unusual to see a "pre-conditioning" system on large refrigeration and air conditioning systems. It isolates the primary system from fluctuating ambient temperatures, ensuring consistent operation, which is particularly important in a medical facility. This is a prime example of lateral thinking – a simple, cheap, yet effective method for achieving a positive outcome that has clearly stood the test of time.

Additional comments and observations provided by **Steve Smith, Affil.AIRAH, Education Relationship Manager at Superior Training Centre.**
Please note that the comments are provided on the basis of the photos only and should be read with this in mind – not all issues or solutions are apparent from a 2D image.

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