University of Adelaide Biomedical Research Vivarium
Setting a new standard of energy efficiency

The University of Adelaide supports the biomedical research community with world standard laboratories specialising in animal products and services. With the proposed Stage 2 upgrade of the Medical School South Buildings Level 6 Laboratory Animal Services in the Adelaide City Campus, the University, under the direction and advice of Systems Design Engineering, commissioned a pilot project at the Waite Campus rodent facility to test the suitability of Air Change heat recovery outdoor air ventilation and air conditioning systems. Among other demanding conditions, the trial called for a minimal level of +/- 1^{o}C temperature tolerance and the ability to provide the same levels of airflow at capacity of 10% part load of full duty. After the trial was deemed a success, the decision was made to use the heat recovery equipment in other University locations.

A major project requiring a HVAC&R central plant upgrade was the University of Adelaide's Medical School Laboratory Animal Services, South Building Stage 2. The consultant for both projects was Elio Colalancia of Systems Design Engineering in Adelaide, specialist engineers and technical advisors who incorporate green technology for sustainable developments. Steve Cook and Frank Johann of long established South Australian HVAC firm, Industrial Air, were contacted by SDE at the early stages of the design to collaborate on the unique requirements regarding an energy efficient air handling system that could meet the demanding design requirements for the laboratory.

A major challenge for the project equipment was to achieve a superior standard of indoor environment for the animals, research staff and students, therefore the design called for high outside air requirement of 15-20 plus air changes per hour of 100% outdoor air with no return air bypass.

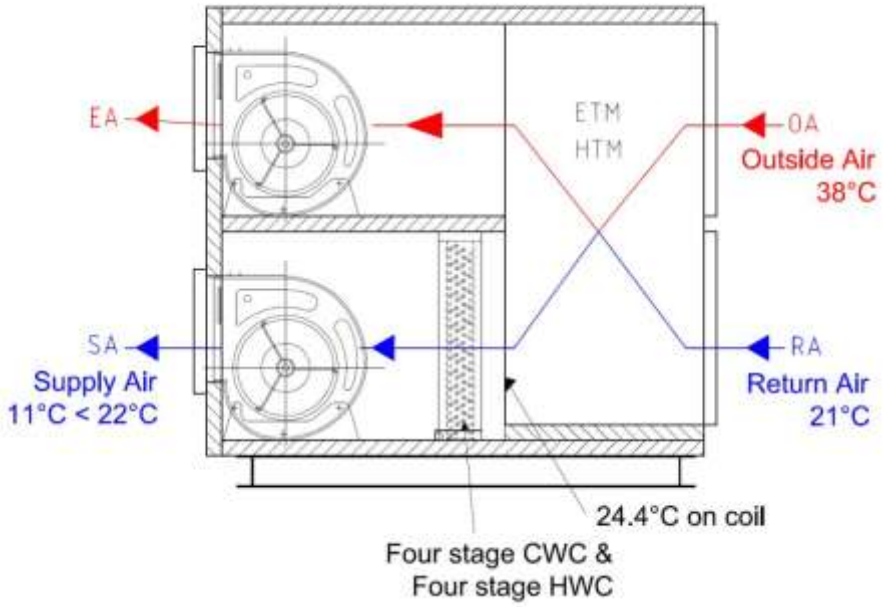
The unique heat recovery designed system was based on recovering and reutilising from 72% to 80% of the exhaust air waste energy, which had never been done before in a Vivarium laboratory (an enclosed area where animals are kept under conditions simulating their natural environment for observation or research). Sensible air to air heat exchangers were to be used to ensure no contamination of outside air with exhaust air. VSD's were required to control the fan speed from BMS via 0-10V low level interface ensuring correct airflow and pressurisation control of the space and to provide high level interface with the building management system to meet the operators design requirements. The laboratory had the same critical temperature requirements as the original Waite Campus trial of 21^{o}C with +/- 1^{o}C temperature tolerance. Normally a chilled/heating water system could only reduce to 40% of capacity but the design called for a capacity as low as 10% of full duty while maintaining the same high levels of airflow. Heat recovery and economy cycle with fully modulating dampers with 0-10V input from the Building Management System were required to give the best stability temperature control in the space. Finally the units had to operate 24/7, so reliability was critical – N+1. A stock of critical components were designated to be kept on site for a quick change over and separate smoke spill fans were utilised for containment control should any AHU go out on a fault.

The Air Change heat recovery range had been designed specifically for energy efficiency and reliability, so most project requirements were already standard equipment. The air to air enthalpy and sensible heat exchangers were a patented counter-flow plate design (no moving parts) and had been proven in the field since 2002. ABB Variable Speed Drives were standard equipment to increase fan energy savings and with "HVAC Series" allow high level interface with BMS. The direct coupled fan and motor system that replaced belts and pulleys from 2005 eliminated time consuming pulley adjustments and resultant down time. Cabinets were constructed in sandwich panel to minimise heat or energy loss through the unit.

An unusual non standard option was the water coil system to provide the modulated response to 10% of coils capacity. Industrial Air designed the coils for the Air Change units. The Four stage cold

and hot water coil design had 25% capacity on each stage, with variable flow for each coil, providing the total coil capacity control down to 10%. The combination of the heat recovery and coil design technologies enables exceptional tight temperature control with 100% outside air supply to be between 11.3°C to 22°C.

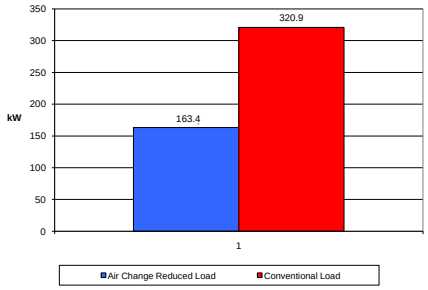
HEAT/ENERGY RECOVERY VENTILATOR
(SUMMER CONDITIONS)



The coil design resulted in excellent trimming control in conjunction with the Air Change heat recovery features. The five (5) Heat recovery air handling units with a total 9907 L/s of outdoor air provided a 157.5kW reduction in peak cooling compared to a conventional air handling system. Total annual running costs for the system were tabulated at $7,716 pa.

UOA Med Lab- - Peak

- 5 X ERV @ total 9,907 l/s OA
- **157.5 kW** reduction in peak cooling



HRV rooftop installation

Frank from Industrial Air explained the background to the installation and manufacturing design to suit: "We discussed the handing of the units with Andrew Robson of Frigrite (FRR Service) and we decided to put the chilled & heating water coil connections on opposite sides of the HRV unit to make the pipe up easier to construct in practice. The chilled water coil connections are on the same side as VSD's and were completed with covers over the valves etc in place. The heating water coils insulation had not been completed so the piping and valves are shown exposed prior to covers being affixed."

Andrew Robson of installing contractor Frigrite commented "The laboratory is an AQIS approved quarantine facility and therefore strict guidelines and commissioning results were essential for the success of the project and ultimately the laboratory itself. Whilst the laboratory remained functional, FRR Service team was able to work within the confines of strict quarantine guidelines and fully upgrade the Universities air conditioning systems to deliver premium quality products and design excellence, ensuring that exceptional energy performance was achieved"

Consultant Elio Colalancia said "We were pleased with the outcome of a substantial peak load and part load savings. Our client was very forward thinking and supported green technology, and provided extra investment to get the best available Australian made equipment and superior controls".

Frank added, "It was a great team effort between System Design Engineering, Air Change, Austec, FRR Service and our company to achieve temperature fluctuations monitored at 0.2^{o}C of set point".

Contacts

Engineering Design & Project Management:	Elio Colalancia, Systems Design Engineering P/L elio.sde@internode.on.net T: 08 8211 6177
SA/WA/NT Distributor/Coil Design:	Frank Johann, Industrial Air frankjohann@industrialair.com.au T:08 8354 0088
HVAC Supplier:	Herman Chiu, Air Change Australia HermanChiu@airchange.com.au T: 02 9531 4699
Installing Contractor:	Andrew Robson, FRR Service arobson@frigrite.com.au T: 08 8405 7400
BMS System:	Cathal McAlinden, Austec cathal@austec-automation.com.au T: 08 8261 1136
Client:	Andrew Bartlett, Manager Laboratory Animal Services, The University of Adelaide andrew.bartlett@adelaide.edu.au T: 08 8303 4665