Go with the flow

Luca Rozzoni of Chatsworth Products (CPI) looks at how to reduce data centre cooling costs through airflow containment

The data centre market continues to grow and more demands are being placed upon facilities to increase energy efficiency and better manage operating costs. However, with the average heat load per cabinet rising steadily and cooling already being one of the largest consumers of energy in a data centre, the task is clearly not an easy one.

HOT AND COLD

Data centre cabinets have traditionally been configured in open hot/cold aisles. The equipment is kept at operating temperature ranges by the room being oversupplied with cool air – a method that wastes energy and is both inefficient and expensive.

Airflow containment, that is the ability to isolate, redirect and recycle hot exhaust air, can lower operational expense (OpEx) by reducing cooling system energy costs and prepare a site for an anticipated increase in server capacity. Only last year, the European Commission published a set of best practice guidelines on data centre energy efficiency in which one of its key recommendations was the implementation of a suitable airflow containment solution.

Complete containment has significant advantages. Hot spots can be eliminated, data centres with air handlers can reduce energy consumption through turning off a number of units or reducing fan speeds, and cooling units efficiencies can be improved to allow for more free cooling hours –that is the number of hours that an economiser can be used instead of a chiller.

THREE OF A KIND

There are three basic methods of complete containment. It is important to know the differences between these three methods to understand the potential benefits and, therefore, be able to determine the best containment solution for a specific need.

COLD AISLE CONTAINMENT

Cold aisle containment (CAC) is frequently used to retrofit data centre environments where a raised floor cooling system already exists. A roof and/or partitions are set up over the cold aisle, with doors at either end. This isolates the cold intake air within the cold aisle, keeping it separate from the hot air in the adjoining hot aisles. The hot exhaust air rises up freely in the hot aisles, and returns through the room to the air handlers.

BENEFITS OF CAC INCLUDE:

- Retrofit suitability for existing hot aisle/ cold aisle environments, especially over a raised floor supply air plenum
- The contained aisle is the cold aisle and provides supply air
- Some CAC solutions can be deployed over uneven aisles
- Sliding doors that require no additional clearance for door swing

CHALLENGES OF CAC INCLUDE:

- It is more complicated and more expensive to deploy and change than a ducted exhaust cabinet system
- Cabinet rows need to be same length, similar height, parallel and aligned

- Additional aisle clearance may be required for the doors at the end of each aisle
- Containment structure may have to be constructed around building columns and other support structures
- Auxiliary equipment has to be in a hot aisle space, which may reduce performance
- A fire suppression system will require changes

HOT AISLE CONTAINMENT

Hot aisle containment (HAC) is commonly used as a containment solution. Essentially, the contained aisles are the hot aisles and the entire remainder of the room is the cold aisle, and provides supply air. By containing and isolating the hot exhaust air from the room, an HAC solution prevents the hot air from reaching the adjacent cold aisles and mixing with the cold air.

In this method, a configuration of ductwork and baffles are set up over the hot aisle, with doors blocking the aisle entrances at either end. The hot exhaust air in the hot aisles is then usually returned to the cooling units through drop ceiling plenums.

BENEFITS OF HAC INCLUDE:

- Eliminates the need for a raised floor
- Delivers cold air from anywhere in the room
- Allows auxiliary equipment to be cooled anywhere in the room (because the room is cool)
- Requires minimal or no changes to the fire suppression system

CHALLENGES OF HAC ARE:

- HAC is more complicated and more expensive to deploy and change than a ducted exhaust cabinet system
- Cabinets must be placed in adjacent hot aisle/cold aisle rows and deployed in pairs to create hot aisles
- The system may require row lengths to be evenly sized, parallel and aligned
- The system requires an overhead plenum and the addition of collars on the air handler units to

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create a closed return, as well as the duct being constructed over the hot aisle
- Optimising operating conditions may require the addition of some instrumentation or heating, ventilation and air conditioning (HVAC) controls

DUCTED EXHAUST CABINETS (VERTICAL EXHAUST DUCTS)

Ducted exhaust cabinets are enclosed server rack cabinets with an attached vertical exhaust duct. The hot exhaust air given off by the servers is enclosed within the cabinet, completely isolating the air from the room. The hot air exits the cabinet through an overhead vertical exhaust duct, which directs the hot air into a plenum above the drop ceiling and back to the cooling units or to outside vents.

BENEFITS OF THE DUCTED EXHAUST CABINET INCLUDE:

- It is the simplest and most cost effective method to deploy and change
- The ducted exhaust cabinet can be placed anywhere in the room and in any position
- No additional aisle clearances are required to deploy a ducted exhaust cabinet, as the locations of building columns and support structures do not impact deployment
- Eliminates the need for a raised floor
- Cold supply air can be delivered from anywhere in the room (strict front of cabinet delivery is not required)

CHALLENGES OF THE DUCTED EXHAUST CABINET INCLUDE:

- A system requires an overhead plenum and the addition of collars on air handler units in order to create a complete closed return, and ducts to be placed above each cabinet. The ducts must be able to extend to the overhead plenum
- Fan speeds on the air handlers need to be adjusted to closely match equipment requirements, which may require some

units to either be shut off or upgraded with variable speed fans
- Requires the addition of some instrumentation or HVAC controls to optimise operating conditions

CHOOSING THE RIGHT SEAL

Whatever containment solution is chosen, it is vital that the seal is given due consideration. A seal's performance is often judged in terms of leakage. This is typically a percentage based on a particular volume of airflow to each cabinet under a specific operating pressure. When comparing these values, it is important to understand that conditions may not match. The volume of airflow should be the maximum sustainable volume across the entire room at the planned static pressure during operation.

Ensuring a seal is effective is not just about having containment barriers without leaks. It also requires total pressure management of the contained environment, particularly with CAC. A complete containment architecture should include an effective pressure differential management system, which may include either introducing or updating the HVAC controls.

BEST PRACTICE

To eliminate bypass airflow within or through the cabinet, the application of the following are recommended:
- Air dams and seals around rackmount equipment to prevent recirculation of hot air around the sides of the equipment
- Seals around cable openings in the cabinet body and raised floors
- Seals between cabinets to block airflow between cabinets into the contained space
- Proper racking techniques to block airflow around rackmount equipment
- Blanking panels to seal all unused rackmount spaces to block airflow between rackmount equipment
- Panels to block airflow under the cabinet into the contained space ■

LUCA ROZZONI

Luca Rozzoni joined Chatsworth Products (CPI) in 2015 as European business development manager. In this role, Rozzoni is responsible for identifying and developing products and solutions that will enable CPI to further meet the needs of its customers in Europe. Rozzoni studied electronic and electro-technic engineering at the Istituto Tecnico Paleocapa and also holds a business degree in strategy development and implementation. He is also a BICSI Registered Communications Distribution Designer (RCDD).