Aisle containment

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As data centre hardware increases to handle the inevitable growth in data caused by new technologies the case for airflow containment for energy-efficiency increases

In a reality where cabinet densities are expected to reach 11 kW by 2020, driving energy efficiency efforts and keeping operating costs down in the data centre has never been so relevant, yet challenging. On one hand, IT equipment within the cabinet must remain operable at all times. On the other, IT managers must ensure that data centre cooling expenses are kept at a minimum. After all, cooling is frequently one of the largest energy consumers in a data centre.

Despite many solutions being introduced in the market, airflow containment – the ability to isolate, redirect and recycle hot exhaust air – has withstood many market trends and stands as the core answer to this juggling act of opposite forces. In fact, the energy savings are so convincing that federal and state governments in the United States are requiring airflow containment in new and retrofit data centre designs. In the United Kingdom, the new 'EN 50600 – Data Centre Facilities and Infrastructures' was developed and published last year, and a set of best practice guidelines on data centre energy efficiency recommending airflow containment was recently published by the European Commission.

Proven to optimise energy efficiency

Many industry associations worldwide have been discussing indirect and direct liquid cooling as possible solutions for high-density applications. But as a recent white paper describes, perimeter cooling is still a highly efficient solution for today's average rack densities and the anticipated densities over the next decade.

In a complete contained system, it's possible to circulate only the necessary amount of cooled air through the data centre, all while removing the heat actually created by the IT equipment. This eliminates the need to oversupply equipment with cool air, resulting in tremendous energy savings.

Furthermore, by developing and implementing a good airflow containment strategy, it's possible to remove hot spots and achieve a lower Power Usage Effectiveness (PUE). Airflow containment and design is also a best practice expected in air-cooled facilities with power densities above 1 kW, according to the aforementioned 2016 EU Code of Conduct on Data Centre Energy Efficiency.

Energy-efficient designs

With equipment densities continuing to increase, allowable inlet equipment temperatures will also continue to rise, so implementing airflow containment brings many advantages in energy savings. In deploying an airflow containment strategy, it's important to address some of the cabinet's openings. Within cabinets, unnecessary openings allow pressurised exhaust air to be pushed to equipment intake ports, so these openings should be sealed to create complete hot/cold air separation. Air dams, filler panels, bottom panels, brush grommets and other sealing accessories can deliver best possible isolation.

Once isolation is achieved within the cabinet, the same approach should be taken to the entire room. There are three basic options, each yielding similar performance but different deployment methods, strategies and life cycle costs:

Vertical Exhaust Duct

A 'chimney' at the top of the cabinet guides hot air to the return system. This is a good approach because the interior back of cabinet will be hot, but the room will be cool. Furthermore, deployment is fairly simple because this strategy

is centred on the cabinet. There are minimal life cycle costs since there's no need for major room remodels. This is a perfect strategy for new or retrofit installations of high- to mid-density output.

1. Hot Aisle Containment (HAC)

This strategy features a barrier that surrounds the 'hot' aisle and provides a return path for hot air. It includes doors at the ends of adjacent cabinet aisles and an overhead Vertical Exhaust Duct. In this scheme, the room will be cool, and the contained aisle will be hot.

HAC implementation requires a more complex deployment and higher investment cost to implement. The HAC system is adaptable to the site, but must be field-fitted to the row. It must also be deployed on an entire aisle with paired cabinet rows and missing cabinet spaces need to be blocked with full-height panels. The higher cost compared to the Vertical Exhaust Duct strategy is primarily due to the deployment by rows, requirement for doors at the end of rows (not required with Vertical Exhaust Duct cabinets) larger duct walls and additional labour to fit the containment system.

2. Cold Aisle containment (CAC)

This strategy features a barrier that surrounds the 'cold' aisle and traps cold air so that it must travel through equipment. This is possible through a 'lid'/ceiling over the aisle and doors at the ends of adjacent cabinet aisles. In this scheme, the room will be hot and the contained aisle will be cold.

CAC also has complexities during installation. First, it must be deployed by an entire row and requires doors at the end of the rows. In addition, CAC typically requires design changes to the fire suppression system, so higher installations costs are common. One potential issue with CAC is that when used in a high-density application, the volume of the contained space may limit the amount of cold air that can be delivered to equipment in the event of a cooling equipment failure.

Future ready designs

Data centres have become the core systems around which businesses operate. Advents such as the Internet of Things (IoT), remote medicine and virtual reality, to name a few, are further pushing the thermal envelope.

The type of containment strategy chosen should be based on business requirements and architectural limitations. For as long as there's isolation from hot and cold air, any method utilised is valid. But planning seamlessly projects is an added bonus to any successful data centre design. ■