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How to Decrease Data Center Cooling Cost up to 40%

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Case studies have shown that by employing passive cooling technology to overcome thermal challenges, you can decrease data center cooling costs up to 40%. The basic principle of passive cooling technology involves using the equipment cabinet as an architectural feature in the data center that secures the isolation between chilled supply air and heated return air. When using a ducted exhaust cabinet, this isolation can effectively cool heat loads in excess of 20kW per cabinet, while maximizing cooling unit efficiency and allowing the air temperature in the data center to be increased.

A case study of a 600kW casino data center demonstrates the savings that can be achieved by using passive cooling technology. This data center contains two rows of low-density deployments with 2 – 2 ½kW per cabinet, two rows of 8kW cabinets, two rows of 16kW cabinets, four short rows of connectivity and three rows with 1 – 1 ½kW per cabinet. The original design was based on standard hot aisle and cold aisle separation with free space return air. There were severe hot spots in the cabinets with 8kW and 16kW. The containment strategy included adding vertical exhaust ducts to the higher-density cabinets to remove the return air into the suspended ceiling space and plenum extensions were added to the cooling units to capture the return air. Suspended ceiling tiles over the hot aisles of the low-density cabinets were replaced with ceiling grates to bring that return air into the suspended ceiling space and minimize its impact on the overall room.

A computational fluid dynamics model confirmed the site audit that the hot air containment changes had eliminated the hot spots. More importantly, the initial scenario required 14 CRAC units with a cooling capacity of 385 tons and still experienced hot spots, compared to the containment scenario which only required seven CRAC units for 220 tons and resulted in no hot spots. The ducted exhaust cabinets and improved tile locations in the containment scenario reduced seven CRAC units from the plan, totaling 165 tons of excess capacity (40% of the original capacity). The reduced capacity resulted from the improved efficiency of the water-cooled CRAC units at higher return air temperatures and the elimination of needing to over-provision airflow to compensate for the wide variation in static pressure typically found under the access floors of most data centers. At 15kW per CRAC and associated chiller plant and assuming a 24x7 operation that gained efficiency reduced this data center's annual electricity consumption for cooling by 919,800 kWh. At $0.09 per kWh, that amounts to over $80,000 in annual savings, plus the reduced capital outlay for the unneeded CRAC units.

The example discussed above demonstrates the challenge of effective cooling in a free space return air environment and the benefits of contained return air using ducted exhaust cabinets. The free space return air environment requires additional cooling capacity to overcome the mixing of hot and cold air in the room. Immediate savings were realized using partial isolation with ducted exhaust cabinets for the highest heat load and by carefully locating supply and return vents throughout the room. Complete isolation with ducted exhaust cabinets and the use of economizers can further reduce cooling cost.