Case study: AirTech
Mentor Graphics Data Center
Wilsonville, OR, USA

QUICK FACTS

- Critical ITE Design Load (Phase 1): 945 kW
- Redundancy: N+1
- Critical load served by (4) 30,000 CFM IASE units. Two of the units include integrated makeup air and humidification.
- Electrical/UPS room cooled by (2) 17,000 CFM IASE units with integrated makeup air
- Recirculation filters: 4" MERV13
- Supply and return isolation dampers
- Natural convection control dampers included, allowing controlled heat rejection during extreme winter conditions with scavenger fans off

Six Oasis IEC units installed on the rooftop of Mentor Graphics' data center in Wilsonville, OR. The company is a world leader in electronic design automation.

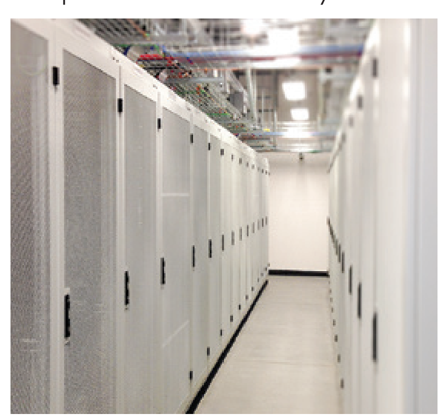
Mentor Graphics selects Munters Oasis® IEC to Cool High Efficiency Data Center

Mentor Graphics Corporation (MGC), a leader in Electronic Design Automation (EDA) technology, made a decision to consolidate several small data centers into a single, larger data center to improve efficiency and meet growing demand. This new, state-of-the-art data center was constructed at the company headquarters located in Wilsonville, Oregon, roughly 18 miles south of downtown Portland.

With their many data centers in operation around the world, MGC facilities engineers had experience with a variety of energy efficient design strategies. The engineers knew they needed to focus on three key aspects of the design to maximize efficiency and minimize cost in relation to the heat rejection aspect of the design: fan energy, hot-aisle containment and minimization of refrigeration cooling.

"In the past, the airflow and temperature requirements of data center cooling equipment were similar to air-conditioning equipment, so air-conditioning was the discipline chosen to fill the need. Today the needs of servers are very different from the needs of people, so air-conditioning equipment struggles to operate correctly in a data center environment," said John Wozniak, MGC's Critical Infrastructure Technician. "While the temperature requirement of the 'intake' of servers is currently similar to the 'intake' of humans, the exhaust temperatures from servers is radically different (much hotter). The approach we took was to implement a design tailored around servers, but also comfortable for humans. Since we could not find precedent for this approach, we relied heavily on Mentor Graphics' FloVENT® computational fluid dynamics (CFD) modeling software to validate the design."

MGC engineers used their own CFD software and in-house expertise to model and optimize the air distribution system.



Munters Corporation, AirTech
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Mentor Graphics selected chimney cabinets with integral electronically commutated (EC) variable speed exhaust fans to house their servers. These cabinets, along with return air ductwork, provide excellent containment of the hot server exhaust all the way back to the roof top air handlers. Although active chimney cabinets cost more than some other forms of hot-aisle containment, they often permit the implementation of a lower cost supply air duct design. For this project, the supply duct from the roof top air handlers terminated in the room up high, with only minimal diffusers under each duct.

The variable speed chimney cabinet fans respond to server loading, speeding up or slowing down so as to maintain a slight negative pressure at the cabinet exhaust plenum (server outlet), keeping the hot exhaust contained. The excellent containment of hot server exhaust allowed Mentor Graphics to raise the design room temperature to 72 – 74°F (22.2 – 23.3°C), resulting in better operating efficiency of the cooling equipment and downsizing of supplemental mechanical cooling.

After evaluating numerous cooling system methods, layouts and manufacturers, the decision was made to use rooftop mounted air handling units manufactured by Munters. Rooftop units maximized the amount of indoor floor space available for the new IT equipment, and they were better suited for the flooded room air delivery system that was ultimately chosen.

Munters' Oasis® air handlers selected for the project operate using the principle of Indirect Air-Side Economization (IASE), where outdoor air is used to reject heat from a recirculating data center airstream by way of an air-to-air heat exchanger. With this approach there are two completely separate airstreams. The first airstream is the recirculating air from the data hall. This air enters the air handlers warm, after server heat pickup, and must be cooled before delivery back to the room. The second airstream is outdoor air, referred to as scavenger air. This air is drawn over the opposite side of the air-to-air heat exchanger by separate variable speed scavenger fans for the purpose of extracting heat from the warmer recirculating data hall air. With IASE systems, only a small amount of make-up air, as required for proper ventilation and space pressurization, is introduced into the data hall. Since the cooling units simply extract heat from a recirculating airstream, they do not impact room humidity levels and risk of ambient pollutants impacting the servers is greatly mitigated compared to direct air-side economizer designs.

Munters' polymer tube heat exchanger was selected for the job because of its high efficiency, resistance to corrosion, and the inherent scale resistance of the flexible polymer tubes. The Oasis® data center units typically operate in a dry mode when ambient conditions are about 40°F (4.4°C) and lower, and in a wet indirect evaporative cooling (IEC) mode in the warmer ambient conditions. During IEC mode, water from an all welded stainless steel sump located beneath the heat exchanger is circulated through piping up to the top of the heat exchanger, where the water then falls down by gravity over the exterior of the polymer tubes. Outdoor scavenger air is drawn up over the exterior of the tubes, leading to evaporation of the water and enhanced heat removal from the warmer data center air that flows through the inside of the tubes. Only during the higher wet bulb ambient conditions, where the wet bulb temperature exceeds 68 – 70°F (20 – 21.1°C), is mechanical "trim" cooling required to meet the target air delivery temperature of 72 – 74°F (22.2 – 23.3°C). Trim cooling coils typically provide a mere few degrees of cooling as needed to get to set point. For the mechanical trim cooling, MGC selected an air-cooled chiller, with chilled water coils installed in the Munters air handlers, located downstream of the polymer HX.


View of polymer tube heat exchanger operating in wet "indirect evaporative cooling" mode.

Munters air handling units were customized to provide optimal efficiency of fans and heat rejection components. For the recirculating (supply) airstream, a fan array using direct drive plenum fans was selected with EC motors (variable speed), each with an inlet back-draft damper. The fan array was configured to provide N+1 redundancy at the fan level. The supply fan motors are controlled so as to provide a slight negative pressure in the return duct. The intent is for the flow of the supply fans in the air handlers to precisely match the flow of air exhausted from the chimney cabinets. The result is optimal efficiency in the cost to circulate the cooling air, which for economizer cooled data centers is the single greatest power consumer.

The air handlers were delivered to the site and commissioned shortly after. Designed to meet a seismic importance factor of Ip=1.5, the air handlers are anchored to concrete roof curbs. During the first year of operation, the system maintained server inlet temperatures throughout the room within +/- 1°F. The operating efficiencies have exceeded Mentor Graphics' expectations, especially in the early stages of operation when data centers are typically least efficient. At the outset, the team's initial target was 5,000 hours per year (57%) of economizer cooling using no compressors. The Munters air-handling units were actually able to economize for nearly 8,000 hours (>90%) during the first year of operation.

"The result of using this quality equipment and the detailed design process has allowed us to be efficient on day one, and from this point on, we are saving money, energy, and everything is working correctly," said Wozniak.

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