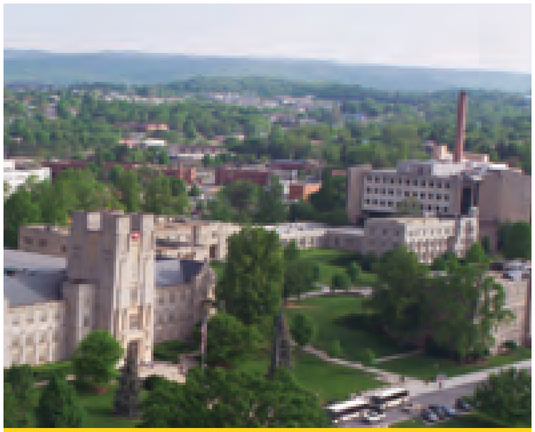
A Customer Success from the Experts in Business-Critical Continuity™



Virginia Tech

Virginia Polytechnic Institute and State University, popularly known as Virginia Tech, is a comprehensive university of national and international prominence. With about 25,000 full-time students and the home of groundbreaking research, Virginia Tech produces world-class scholarship in a challenging academic environment.

Background

When Virginia Tech initiated plans to build a supercomputer by clustering hundreds of desktop computers, it had ambitious goals for the performance of the new system and a very aggressive schedule. The final plan involved a cluster of 1,100 64-bit Power Mac G5 dual-processor computers. If successful, this cluster would significantly expand the university's capabilities and enable it to simulate the behavior of natural or human-engineered systems, rather than relying on observation or physical modeling. But the cluster created significant cooling challenges that could not be addressed through traditional approaches to cooling.

Case Summary

Location: Blacksburg, Virginia

Products/Services:

- Liebert XD cooling system
- Liebert Foundation® racks

Critical Needs: Provide focused high-capacity cooling for supercomputer cluster.

Results

- Eliminated the need to build a new data center for the supercomputer.
- Optimized energy efficiency and space utilization.
- Fast response from Liebert and other partners enabled the project to stay on an aggressive schedule and qualify as the world's third-fastest supercomputer.

Liebert

EMERSON™ Network Power

The Situation

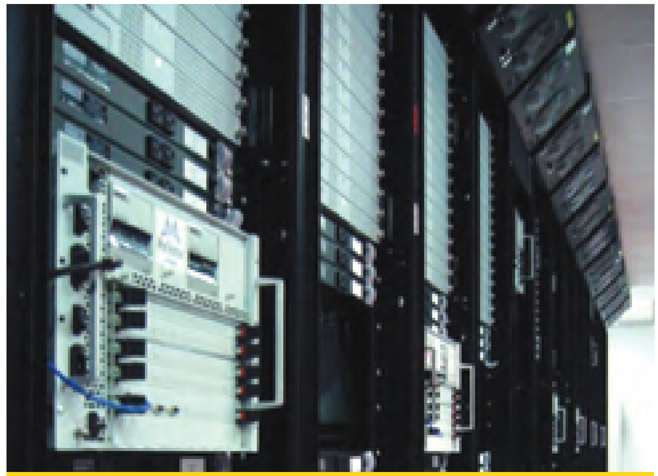
The supercomputer designed by Virginia Tech computer scientists used 1,100 Macintosh G5 computers clustered using Infiband technology from Mellanox™ Technologies for primary communications and Cisco® switches for secondary communications. The cluster also used a software program called Déjà vu, developed at Virginia Tech, to solve the problem of transparent fault tolerance, enabling large-scale supercomputers to mask hardware, operating system and software failures.

The project was not only significant to Virginia Tech. It created a new model for supercomputer development that could bring supercomputer power within reach of organizations that had not previously been able to afford it. But the challenge the scientists at Virginia Tech were unable to address was keeping the cluster cool.

The cooling solution for such a high-density room required a level of innovation along the lines of the university's supercomputer itself. Inadequate cooling would result in processors and switches operating in dangerously high temperatures, reducing performance and life span.

Emerson Network Power was prepared to address this challenge through its Liebert family of cooling technologies. Liebert power and cooling specialists played a key role in helping the university understand the magnitude of the challenge, evaluate alternatives and configure the room for optimum cooling.

"Liebert really helped open our eyes to the challenge of heat removal on this project," says Kevin Shinpaugh, director of research and cluster computing at Virginia Tech. "When you are pioneering a new approach as we were, you are in uncharted waters. Liebert was able to bring a detailed understanding of the challenge as well as a very well-developed solution."



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Kevin Shinpaugh, director of research and cluster computing, Virginia Tech

Working with preliminary project specifications, Liebert specialists analyzed equipment power consumption and projected heat loads. Then, using computer air flow modeling, they determined the optimum arrangement of racks and began to model different cooling-system configurations.

Each configuration was based on the "hot aisle/ cold aisle" approach to tile placement and rack arrangement. In this approach, cold aisles have perforated floor tiles; the hot aisles do not. Racks are arranged front-to-front so the air coming through the tiles is pulled in the front of the rack and exhausted out the back into the hot aisle.

Once different approaches had been reviewed, the specialists analyzed two configurations in depth:

1. Relying exclusively on traditional precision air conditioning units; specifically, the Liebert Deluxe System/3.
2. Creating a hybrid solution that combined traditional computer room air conditioning units with supplemental cooling provided by the Liebert XD system.

The Traditional Approach to Cooling

Based on the data available, the Liebert specialists projected a sensible heat load of 1,972,714 Btu/hr for the 3,000-square-foot facility.

Assuming this heat load, the room would require a total of nine Liebert 30-Ton Deluxe System/3 precision air conditioners—seven primary units and two backups. The seven Deluxe units would generate a total sensible capacity of 2,069,200 Btu/hr and 106,400 CFM. Based on these CFM requirements, the facility would need 236 perforated floor tiles, totaling 944 square feet (based on normal per-tile airflow of 450 CFM). These tiles would cover nearly one third of the total floor space.

Airflows were then analyzed using the TileFlow modeling program, assuming an 18-inch raised floor. With this configuration, the volume of air being pumped under the floor created extremely uneven airflows—from -70 CFM to 1,520 CFM.

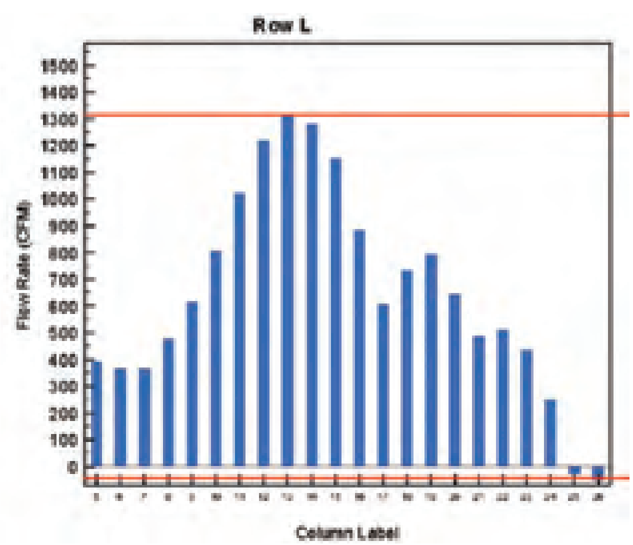
In addition, under-floor pressures and velocities demonstrated significant tumult beneath the floor, reducing cooling system efficiency and creating the potential for hot spots that could damage the computers and reduce availability.

The engineers then evaluated the effect of raising the floor from 18 inches to 40 inches to equalize airflow in the room. This change improved the situation, but still resulted in less than optimum cooling. A 40-inch raised floor was impractical because of physical limitations of the building.

The Hybrid Solution

Precision air conditioning units such as the Liebert Deluxe System/3 have provided effective cooling in thousands of data centers around the world; however, high-density systems, such as the Virginia Tech supercomputer, are stretching these systems beyond their practical capacity.

In response, Liebert developed an alternate approach that uses fewer room-level precision air conditioners, reducing pressures under the floor, and supplements these units with rack-based cooling systems.



Airflow analysis across one row of racks using floor mount precision air conditioners with 18-inch raised floor.

Liebert specialists analyzed airflow from two 20-ton Liebert Deluxe units and confirmed that the two units achieved a more uniform air flow; variance within the room was reduced from more than 400 CFM to less than 100 CFM. With uniform airflow established, Liebert specialists calculated the optimum configuration of supplemental cooling systems using the Liebert XD system.

"Liebert was one of the few companies that had developed a viable cooling solution for high-density computer configurations," says Patricia Arvin, associate vice president, information systems and computing, Virginia Tech.

"It was clear that traditional approaches to cooling would not be sufficient by themselves," adds Shinpaugh. "Fortunately, Liebert had a solution."

The Liebert XD is a flexible, scalable and waterless solution to supplemental cooling that delivers sensible cooling of heat densities higher than 500 Watts per square foot.

The Liebert XD family uses an environmentally friendly coolant to achieve high efficiencies and waterless cooling. The coolant is pumped as a liquid, converts to a gas within the heat exchangers, and then is returned to the pumping station, where it is re-condensed to liquid. The system achieves high efficiencies by placing the cooling system close to the heat source and utilizing the heat absorption capacity of a fluid changing state.

The Liebert XD family includes vertical rack-mounted fan coils (Liebert XDV modules) and ceiling-mounted fan coils (Liebert XDO modules). Based on available

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ceiling height, Liebert recommended the Liebert XDV for both hybrid configurations presented to Virginia Tech.

One Liebert XDV cooling module was recommended for every other rack. This configuration provides ample cooling capacity to meet initial requirements, with the ability to expand capacity should heat densities increase as a result of changes to, or expansion of, the supercomputer.

The Liebert XD system can utilize its own chillers or connect to the building chilled water system. Both options were analyzed for Virginia Tech. Liebert and Virginia Tech selected reciprocating air-cooled chillers, which supply chilled water to the Liebert XDP Heat Exchanger/Pumping module.

The Solution

Based on the detailed analysis conducted by the Liebert engineers, it was clear that the combination of two Liebert 20-ton Deluxe System/3 room air conditioners and 48 Liebert XDV supplemental cooling modules delivered the optimum cooling solution for the supercomputer facility.

To further ensure proper performance of the cooling system, Liebert custom-built the racks for the Power Macs. In addition, Liebert provided the three-phase UPS system that provides backup power and conditioning for the supercomputer cluster.

The Results

Within less than three months of receiving the preliminary specifications for the room, Liebert had analyzed multiple cooling system configurations, developed the optimum room layout and cooling solution, custom designed racks to equipment requirements and provided the power and cooling equipment for the new supercomputer.

According to the *New York Times*, the computer "was put together in a virtual flash."

And, the results have been impressive. In its first year of operation, the Virginia Tech supercomputer achieved speeds of 10.28 teraflops, making it the third-fastest supercomputer in the world.

"Liebert has been an extraordinary partner in this endeavor," says Arvin. "They worked with us to find a solution to every problem we've encountered, and they have done it in record time. It's rare to find a company as large as Liebert that can act so quickly and be so agile in responding to a customer's needs. It's like having a Ferrari custom designed and built with the efficiency of a Toyota. We are very impressed."

But then, Virginia Tech has done no less itself by building one of the most advanced super computers in the world, using basic desktop components.