SANDIA NATIONAL LABORATORIES

A Vertiv™ Case Study

VERTIV

ABOUT THE COMPANY

Sandia National Laboratories has developed science-based technologies to support U.S. national security since 1949. This government-owned and contractor-operated facility supports the U.S. Department of Energy's National Nuclear Security Administration and has major research and development responsibilities in national security, energy and environmental technologies and economic competitiveness.

Background

Sandia National Laboratories supports United States national security by providing science-based solutions to address threats from terrorism, cyber attacks, uncertainties over energy security and infrastructure and other challenges. To support their extensive research and development initiatives, Sandia's IT managers are faced with consistently updating and implementing the newest, fastest and most reliable supercomputer technologies. When the laboratory sought to deploy a new supercomputer, the Sandia's IT Facility Infrastructure and IT professionals convened to advance their approach to high-density cooling to meet Sandia's critical need for high availability, while improving energy efficiency and processing speed.

Case Summary

Location: Albuquerque, New Mexico, USA

Vertiv Solutions:

- Liebert XDR rack door cooling module applied as the Sun Cooling Door

- Liebert XDP refrigerant pumping units

Critical Needs: Support high-performance computing needs while maximizing energy efficiency and delivering maximum availability.

Results:

- Applied a rack door, refrigerant-based passive cooling system capable of removing 90 percent of server heat load before it leaves the rack.

- Reduced energy costs by 77 percent by replacing 140 racks operating at 13 kW per rack with 36 racks operating at 32 kW per rack.

- Minimized the organization's environmental footprint by incorporating innovative high-density cooling technologies.

SANDIA NATIONAL LABORATORIES

A Vertiv™ Case Study

The Situation

At a time when terrorism and other threats are top concerns, Sandia National Laboratories, which develops science-based technologies to support national security, continuously works to implement cutting-edge data center infrastructure strategies to support the IT systems its laboratories and customers depend on. With data center usage rising, Sandia needed to deploy a new supercomputer. Sandia's IT Facility Infrastructure and IT professionals decided to use the opportunity to assess the reliability, availability and efficiency of their cooling systems, and employ new, advanced technologies to optimize energy efficiency and further address the organization's critical need for High Performance Computing.

Sandia's effective but aging supercomputer, named "Thunderbird," consisted of 140 racks operating at full capacity of 13 kW per rack. The five-year-old system could process data at a rate of 50 teraflops and relied on 518 tons of cooling, fed by 12.7 million gallons of water each year. With limited floor space, the system had little room for growth, and given the critical nature of its operations, Sandia could allocate only a day and a half of planned downtime throughout the year for scheduled maintenance.

"We were looking for a power and cooling infrastructure that would support our customers' needs as well as have room to grow in the future," said Dave Martinez, Data Center Facilities Coordinator at Sandia National Laboratories. *"There are a lot of people throughout the world who access our data center for their critical applications, so we felt the need to implement a faster, more reliable infrastructure to maintain the high level of availability and to improve efficiencies at the same time."*

Liebert XDP pumping units act as an isolating heat exchanger between the building chilled water source and the circulating refrigerant. The compressor-less units operate above dew point, providing 100 percent sensible cooling.

The Solution

IT Systems and IT Facility Infrastructure professionals worked together to design and deploy an innovative, high-density IT system and supporting data center infrastructure that could fit within the existing facility and meet current and future IT needs, while providing the flexibility to support future growth. Named "Red Sky," the new supercomputer dramatically increased the density of the space by consolidating 140 racks to just 36 racks, operating at 32 kW per rack. To support this virtualized and highly-dense computing environment, the team needed a leading edge, close-coupled cooling infrastructure to accommodate extreme compute densities in a cost-effective manner.
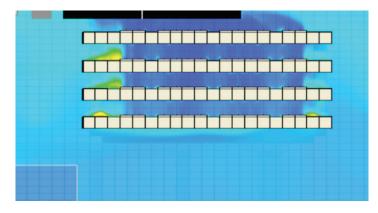
"Supercomputing is invaluable," said Martinez. *"That is why we like to do innovative projects with a twist to support our supercomputing needs. We reviewed bids from three or four different vendors to identify the most energy-efficient cooling solution, but the one that was the most attractive was Vertiv's Liebert XDR solution, applied as Sun Cooling Doors."*

The Liebert XDR solution was the first refrigerant-based, 100 percent passive cooling rack door system on the market. It requires no fans, and utilizes a pumped refrigerant that is 70 percent more efficient at removing heat from the IT rack, while eliminating the possibility of equipment damage caused by water leakage. The Sun Cooling Doors employed by Sandia are a private-label Liebert XDR door, which easily attaches to the back of most racks. This system provides 2.3 times the capacity of competitive passive cooling systems.

In the Red Sky deployment, air inside the racks reaches temperatures as hot as 130 degrees Fahrenheit, but upon passing through the Liebert XDR cooling doors, is discharged into the next row at 72 degrees. The Liebert XDR solution removes 90 percent of the IT heat load before it leaves the rack. The doors leverage the server fans to move air across the micro-channel coil, eliminating cooling unit fans and reducing electricity costs.

Since the expelled air is cool enough to feed a cold aisle, a laminar airflow configuration—circulating air in parallel-flowing planes—is employed to further enhance cooling efficiency. Perforated floor tiles are only required to support the first row of racks, with the 72-degree air expelled from the first row feeding into the front of the next, and cascading through each rack row. Air discharged back into the room is cooled to the point where the impact on the room is close to room-neutral.

Liebert XDP pumping units act as an isolating heat exchanger between the building chilled water source and the circulating refrigerant. The compressor-less units operate above dew point, providing 100 percent sensible cooling.

"From the Liebert XD units on the chilled water side, we took the return water and supplied it to our CRAC units in the room, raising the Delta-T up, also enabling us to bring the sensible cooling up even more," said Martinez. *"So we were already really efficient with the Liebert XD systems, and then we raised the sensible cooling up in the room by delivering warmer water to our CRAC units."*

The Red Sky supercomputer uses a laminar airflow configuration, with perforated floor tiles required only in the first row of racks. The 72-degree air expelled from the Liebert XDR cooling doors feeds into the front of the next rack, and cascades through each rack row.

The Results

Since deploying the Red Sky supercomputer, Sandia has reduced both energy consumption and carbon footprint associated with the supercomputer by more than 75 percent, thanks in large part to the energy and water savings provided by the Liebert XDR solution. Annual water consumption needed to support cooling for the supercomputer has dropped by 5.7 million gallons, while chiller plant consumption and cost have fallen 37 percent.

By cooling heat loads directly at the source—before the hot air ever enters the room – Sandia has significantly enhanced the efficiency of its cooling systems while simultaneously accommodating even more computing power, within a smaller data center footprint. While Sandia's Thunderbird supercomputer could handle 13 kW per rack at full load, Red Sky can accommodate up to 32 kW per rack. Simultaneously, whereas Thunderbird required 518 tons of cooling to manage temperatures within the relatively high-density system, the new Liebert XDR solution requires just 328 tons of cooling to accommodate nearly six times the power capacity.

Efficiently cooled using the Liebert XDR solution, Sandia's Red Sky supercomputer ranks among the world's top 15 fastest supercomputers. Previously, the entire Thunderbird supercomputer could process 50 teraflops using all 140 of its racks, but Red Sky can process approximately 10 teraflops within each rack, running at 433 teraflops, or 433 trillion calculations per second.

Leveraging Red Sky's speed and capacity, Sandia partnered with the National Renewal Energy Laboratory (NREL), which specializes in the research and development of renewable energy and energy efficiency technologies. Using the Red Sky supercomputer, NREL can now generate its research results within four to six weeks, compared to previous efforts, which consumed four to six months.

"Sandia National Laboratories are critical to our nation's path forward," said Martinez. *"We continue to make innovative adjustments to the new infrastructure because we have the capacity to do so, and because we want to continue to be at the leading edge of the computing world."*

For more information on Vertiv and Liebert solutions, visit: www.VertivCo.com

For more information on Sandia National Laboratories, visit: www.sandia.gov/