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Cooling Case Studies

GEIST COOL

About **Geist**

Geist designs and manufactures industry leading technology and software for powering, monitoring, cooling and managing critical data center infrastructure. We produce affordable, quality products while providing our clients with superior service. Whether it's enhancing customer care services or implementing new technologies, Geist promotes innovation, quality and satisfaction in all aspects of business.

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Case Studies

High-Density Research Computing Initiative

University of Calgary New Research Data Center

Calgary Center of Innovative Technology (CCIT)

Case study | EC8003A
Published May 2012

Agriculture and Agri-Food Canada

Uptime Institute GREEN ENTERPRISE IT AWARD 2011

Deployment of High-Density Computing for CCIT Research Initiative

The University of Calgary attracts researchers from across the globe to their new world-class CCIT research computing facility. Here they investigate new cutting-edge techniques for maximizing oil production from the oil sands fields using the cleanest, most efficient methods. The new, high-density, high-performance CCIT facility has a total power and cooling capacity of 600kW within 1100 square feet, facilitating computing for several researchers. A total of 20 racks in the facility have been provisioned to each handle 20 kW. With the Geist Cool system dynamically adjusting with the cabinet compute load, the thermal environment is relatively the same temperature as the supply air temperature, even with the high-density computing environment on a slab floor.

University of Calgary's CCIT

The University of Calgary is a global intellectual hub located in one of Canada's most enterprising cities. In this spirited, high-quality learning environment, students will thrive in programs made rich by research and hands-on experience. By their 50th anniversary in 2016, the University of Calgary will be one of Canada's top five research universities, fully engaging the communities they both serve and lead. The University currently services approximately 59,000 students, faculty, researchers and alumni. The new CCIT facility is one of five data centers operated by the University, consuming over 2.5 megawatts of total power.

Research Compute Performance

The CCIT space is a non-raised floor environment with no hot or cold aisles. It accommodates 20 Geist Cool high-density cabinets with Geist Cool intelligent-integrated power to distribute power to each cabinet. Five 30-ton nominal glycol-cooled CRAC units, located around the perimeter of the room, provide the cooling. In addition to these units, each cabinet is provisioned with an Geist Cool EC20 system to manage and control airflow at the rack. Each system will remove air from the cabinet at the same rate that the servers exhaust hot air. This Geist Cool system will dynamically adjust with the cabinet compute load based upon pressure rather than temperature.

Data Center Design Goals to Support CCIT initiative

"Energy Star-rated servers used in conjunction with the Geist Cool system allows return temperatures to the CRAC units in the high 80s and very low server airflow rates – giving high temperature differential between server intake and server exhaust," said Kevan Austen, Manager of Data Centre & Facility Operations for the University of Calgary. The climate in Calgary provides free cooling for around 300 days a year, further reducing energy consumption. "With the Geist Cool containment system, we planned to safely raise our supply air temperature to further increase our economizing opportunity."

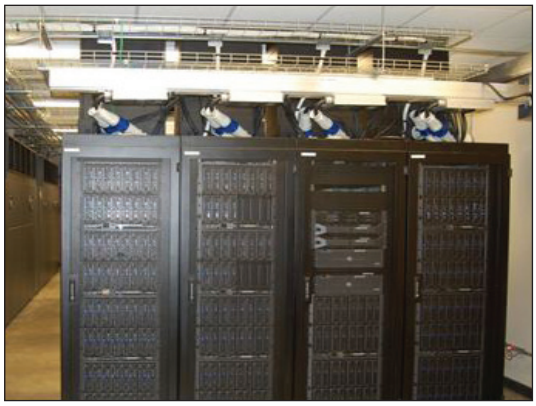
The engineering firm of record on this project was very impressed with the ease of design and flexibility of this system compared to other high-density solutions. This was their first project using CRAC units on a slab floor. By using Geist Cool's containment systems, they had the ability to use standard components that the university facility engineers were comfortable to operate and maintain. The design firm indicated they will design around the Geist Cool system again on future projects.

CCIT Decision Criteria for Selecting Geist Cool

The University investigated many high-density solutions to accommodate the high-performance computing facility. Solutions such

> Geist Cool's systems were installed quickly and are very easy to maintain and operate. One of the features we liked most is the ability to allow our staff to provision compute load in any cabinet without having to worry about hot spots or getting temperature alarms.

as; in-row cooling, overhead refrigerant systems, and passive containment methods were evaluated. "Based upon the load, cost and space limitations, the Geist Cool system and solutions were chosen as the most cost-effective and energy-efficient solution available," said Austen. "Geist Cool's systems were installed quickly and are very easy to maintain and operate. One of the features we liked most is the ability to allow our staff to provision compute load in any cabinet without having to worry about hot spots or getting temperature alarms." Airflow control has been around for some time and is primarily used in the control of airflow in laboratories and other healthcare facilities. By using pressure rather than temperature, the system will be more accurate and adjust to accommodate the actual server airflow rather than targeting a hotspot.



Keeping Water Off the IT Floor

"By implementing the Geist Cool solution with efficient perimeter cooling, we kept all water and refrigerant at the perimeter of the data center and as far away from the IT equipment as possible. With the Geist Cool system, we didn't have to place cooling next to the IT gear. This system operates in the same effective manner without moving water or refrigerant closer to the cabinets while also saving valuable white space. By not having to run refrigerant or water lines to the data center floor, the installation was extensively simplified," said Austen.

CCIT Future Plans

Based on the addition of new research and the funding being provided, the University expects to be out of available power in this computing facility in the next 12-14 months. "We are currently planning our next data centers around the use of Geist Cool integrated power, cabinets and intelligent containment," Austen said. "The peace of mind that the award-winning Geist Cool components and systems provide, along with their support, are the reasons why we will most likely continue utilizing Geist Cool on future projects."

Environmental Leadership

Researchers who are investigating cutting-edge techniques for maximizing oil production using the most efficient methods will respect and benefit from CCIT's leadership for efficient data center computing. With the Geist Cool system automatically adjusting to the dynamic nature of the Energy Star-rated servers based upon pressure, all server exhaust heat will be returned to the cooling units. Safely raising supply air temperatures will maximize the free cooling using the economizer circuit. CCIT expects to receive greater than 300 days of free cooling per year.

Agriculture & Agri-Food Canada (AAFC) Winnipeg Keeps Pace with Aggressive Data Center Growth Demands by Reclaiming Wasted Cooling

AAFC Reclaims Wasted Cooling

Case Study | EC8002B
Published August 2010

Uptime Institute GREEN ENTERPRISE IT AWARD 2011

AAFC Winnipeg Data Center is Meeting Aggressive Growth Demands

The challenge for AAFC's data center services was to grow approximately 40% with limited infrastructure investment. With Prairie HVAC's assistance, the Geist Containment Cooling systems enabled AAFC to quickly meet aggressive growth demands on data center services that were previously not possible given the center's cooling infrastructure. Geist Cool's ability to actively manage rack airflow, with redundant fans and a secure Web server to email alerts and provided metrics, was significant in enabling intelligent cooling decisions. This in turn enabled higher power density racks and increased cooling efficiencies throughout the data center. Prairie HVAC provided and implemented the Geist Cool intelligent containment. Upon installation of the first intelligent containment system at AAFC, the benefits were demonstrated and allowed the continued deployment of intelligent containment systems to further optimize the AAFC Winnipeg data center.

AAFC's Winnipeg Data Center

AAFC Winnipeg is their second largest AAFC computer facility. AAFC Winnipeg is aggressively increasing IT load and expecting to continue this trend over the next several years. However, the data center, implemented almost 20 years ago and with only a six inch raised floor, is currently operating beyond its designed load. Efficient use of the current cooling resources through best practice airflow management was helpful until recently. AAFC Winnipeg desired to further improve airflow efficiencies on a couple of racks targeted for higher power densities.

Attempting to Deploy More IT – Fall of 2009

With the existing cooling infrastructure, the AAFC Winnipeg data center was unable to deploy blade servers without causing server temperature alarms and intake temperatures greater than 30 ºC (86 ºF). A single passive rack chimney was placed on one rack with a ducted exhaust to the ceiling plenum. This further exacerbated these conditions even though the rack was outfitted with solid rear doors, bottom and top panels, as well as some manufacturer-provided weather-stripping.

Blade Chassis Overheating Issue

After approximately 48 hours of operation, blade chassis #2 (with a 4.5 kW load in R7) had to be shut down due to excessive local heat problems and increased temperatures throughout this region of the data center.

Detailed observation showed Rack R7 leaking a large percentage of hot air out of the rack due to high rear-rack plenum pressure. Multiple and parallel server air streams, all merging in a tight space, could not be expected to evacuate the passive rack chimney without building localized pressure and resulting in hot air leaks. A local helper fan would be required to remove the rack back pressure and resulting thermal issues.

> Applying innovative products like the Geist Cool containment solution on a large scale will increase future savings through a more efficient and actively managed cooling system. This will ultimately work towards reducing cooling infrastructure costs.

Deploying More IT with Just One Geist Cool Containment-Cooled Rack

The Geist Containment Cooling system converted Rack R7 from a passive rack to a dynamic active rack. AAFC decided to go with the Geist Cool system with its redundant fans and ability to automatically control airflow through the rack, while ensuring a zero-pressure environment inside the rack. The other Geist Cool benefits include; the ability to remotely monitor cooling capacity, log IT equipment intake heat and humidity, and set up email alert thresholds to multiple alert groups.

AAFC simply removed the metal duct and replaced it with the Geist Cool system, all while two-blade chassis in Rack R7 remained operational. The ceiling was trimmed for the Geist Cool exhaust duct, which was half the depth as the prior duct. AAFC was confident the servers would operate more efficiently by reducing back pressure and ensuring that no hot exhaust bypassed the chimney, finding its way back to the front of the rack.

Powering Up the Blade Server Chassis

With the Containment Cooling system installed, AAFC emulated full power to blade chassis #2 in Rack R7, resulting in an operating third blade chassis without temperature alarms. In addition, AAFC observed that the:

- Geist Cool temperature graphs showed the exhaust heat increase steadily as expected to 35-36 ºC (95-97 ºF) at the Containment Cooling duct exhaust. 23 ºC (73 ºF) was maintained to the rack intake at all heights.
- Data center temperature was acceptable. Eye-level readings at each rack varied from 19.5 ºC (66 ºF) to a high of 25 ºC (77ºF). The exception was Rack R19 (with the other blade chassis), which was near 27 ºC (81 ºF). Neighboring racks on either side were at 25 ºC (77 ºF).

More IT Deployed into Geist Cool Rack R7

To take advantage of the actively managed containment system, a blade chassis was moved from Rack R19 to the Geist Cool Containment-Cooled Rack R7. This assisted overall data center cooling by increasing the power density in the successful Geist Cool rack and reducing 4.5 kW of heat load from Rack R19. The most important findings and benefits were:

- Ability to operate all three blade chassis in Rack R7
- Geist Cool's metrics once again proving invaluable for deploying more IT load
- Reduced mid-room intake temperatures a few degrees near Rack R7
- Timely enabling of new virtual servers in Rack R7 while keeping rack temperatures stable

Main Benefits of Geist Containment-Cooling Deployment at AAFC

- Aggressive growth demands with limited infrastructure investment
- Fiscal responsibility with environmental leadership
- 40 percent increase in data center load without hot spots or airflow problems
- Intelligent cooling decisions with a secure Web server to email alerts and provided metrics
- Maximized IT and real estate resources in a 20-year-old data center with a six-inch raised floor
- Efficiency gains and reduced wasted cooling by raising supply air temperature
- Ability to utilize existing Glycol-cooled DX CRAC units at the floor perimeter

Knowledge Transferability

AAFC can apply the significance of a managed containment-cooled system, with load and environment metrics, to make intelligent cooling decisions in other data centers:

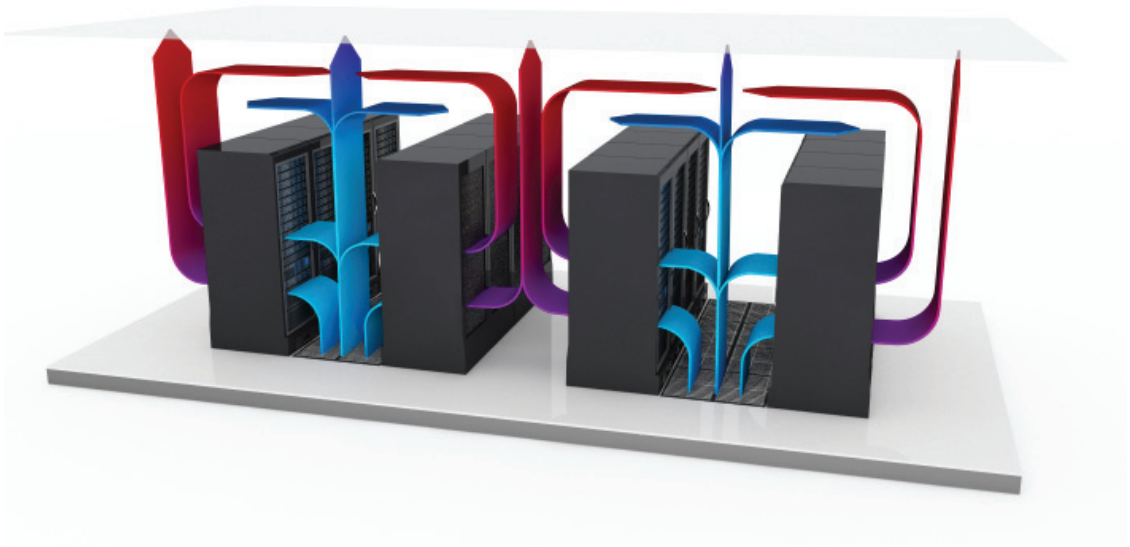
- Increase utilization of existing cooling infrastructure
- Deploy higher density racks with confidence, success and without confusion
- Valuable remote real-time monitoring of temperature and humidity across the data center
- Achieve high-density rack deployment with a traditional cooling infrastructure
- Achieve immediate benefits of rack deployment and reduction in data center energy consumption
- Achieve load increase and energy savings with a lower-than-desired raised floors
- Significant savings – Ideal for infrastructure and energy cost reductions

Data Center Services Expansion with Limited Resources

The Geist Containment Cooling solution excelled even with AAFC's congested low-raised floor environment, and proved invaluable in allowing AAFC to understand airflow-related dynamics necessary to optimize AAFC data center operations. Just a few Geist Cool containment systems enabled AAFC to meet the most recent growth demand through effective use of cooling resources. The information provided through the Web server metrics and alerting features has proven to be as valuable as the automated airflow management. Many IT resources have access to the data center (physically and remotely) and it doesn't take much to change the dynamics in a rack or the data center. For example, remotely powering blades on or off normally has a significant impact, but it's not an issue with the active (automated) airflow management.

Fiscally Responsible Environmental Leadership

Applying innovative products like the Geist Cool containment solution on a large scale will increase future savings through a more efficient and actively managed cooling system. This will ultimately work towards reducing cooling infrastructure costs required for AAFC's rapidly growing data centers (lowering space, procurement, maintenance and power costs).



Studies show 250 percent over-cooling is required when hot air is uncontrolled.*

Without heat containment, hot air mixes with cold, leading to gross over-cooling. Geist Cool addresses this problem by focusing on containing hot air to improve cooling efficiency by up to 40 percent.

* ""Designing Better Data Centers"," ***ASHRAE Journal***, 12/07, EPA - Uptime Institute conference material

Intelligent Cabinet or Row Containment

The Geist Intelligent Containment System centers on two critical components: 1) containing heat and 2) expelling heat directly to the Computer Room Air Conditioning (CRAC) units. This two-step focus maintains and stabilizes the ideal temperature for data center equipment.

A. Custom Chimney

Geist Cool chimneys exhaust the cabinet's hot air through the ceiling return plenum or to other desired locations. Chimneys are adjustable to accommodate most ceiling heights. Durable and easy to assemble, each chimney is made of powder-coated steel, matching most data center cabinets.

Adjustable duct extender kits: EC1002-0007X, EC1002-0013X
Fixed length stackable ducts: EC1002-08S, EC1002-12S, EC1002-24S, EC1002-48S

B. Fan Units

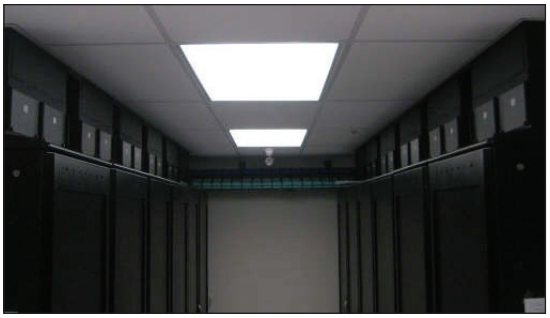
Geist Cool fan cartridges evacuate hot air to maintain air flow at the exact rate the IT equipment generates. Each fan unit is manufactured with best-in-class components to ensure maximum run life and unparalleled efficiency.
EC10D, EC20D

C. Intelligent Controller

The intelligent controller is the brains behind Geist's Enterprise Cooling (EC) system. It automatically adjusts fan unit speeds to exhaust exactly the right amount of air from each cabinet. The fan speed is controlled by information from pressure sensors that compare pressure inside cabinets with that in the room. The EC system works to maintain a zero differential between the two environments. The intelligent controller also logs and records valuable temperature and performance data.
EC1001H

40-billion dollar Energy Provider Knows how to Keep Pace in a Rapidly Changing IT World

Husky Energy Green High-Density Computing



Case Study | EC8001A
Published August 2010

Husky Green Data Center Initiative

The automated high-density cooling distribution system deployed by Husky Energy is actively managed and provides over 320 days of free cooling per year by using the Geist Containment Cooling® System, raising the supply air temperature and using a free economizer glycol loop to outdoor dry coolers. Husky's green computing facility provides flexible IT deployment, such as the ability to deploy high-density blade and server racks anywhere while maximizing free cooling hours.

Husky Green High-Density Computing Initiative

At the heart of Husky's green high-density computing initiative is Geist Cool's innovative cooling distribution system that contains the heat, dynamically scales to the IT load in real-time, and reports cooling load data and alarms. Installation and set-up for the Containment Cooling system was quick and easily adapted to Husky's choice of IT equipment racks, precision cooling and IT management software.

"We can maintain the same intake air temperature to every location in the room and automatically scale to the IT load, so every piece of IT equipment is working as efficiently and reliably as possible–no hot spots and no pressure buildup in the rack," said Dave Oliver. "With Containment Cooling, we have the ability to average 8 kW-per-rack and take any racks we choose to 20 kW, even in the 11-foot slab-to-slab urban setting."

Goals for Husky Energy's Green Computing Facility

- Maintain a stable environment within a low slab-to-slab high-rise building
- High-density computing that maximizes IT and real estate resources
- Conform to the green energy mandate with a PUE of 1.4 or less
- Full IT flexibility with the ability to locate high-density racks anywhere
- Utilize familiar and time-tested, Glycol-cooled DX CRAC units at the floor's perimeter
- Utilize outdoor dry coolers to achieve over 320 days of free cooling per year
- Containment and continuous cooling distribution during a utility failure

Before the Automated Containment Cooling System…

With inadequate supply air volume in front of the rack, high-density equipment was pulling in hot exhaust air. When deploying higher density equipment, the volume of air pulled through the IT equipment rack exceeded the volume of cool air distributed at the face of the rack, resulting in hot air recirculation to the equipment intakes.

Floor Tile Gymnastics

Actual tile flow rates varied significantly and, on average, were lower than expected. Achieving desired flow rates from floor tiles, or other cool-air delivery methods, in front of every IT rack on the floor is complex and highly dynamic. Affecting under-floor pressure, and the resulting tile flow rates are: size, floor aspect ratio and height, tile positions and types, presence of floor leakage paths, size and orientation of CRAC/H (Computer Room Air Conditioner/Handler) units, under-floor obstructions, CRAC/H maintenance, and under-floor work.

> Geist Cool software is providing real-time cooling load and environment monitoring as well as critical alarms at the management console level.

Cooling Over-Provisioning Approach

Husky's previous data center had an over-provisioning of the cooling volume and a reduced air temperature, which was below the recommended ASHRAE lower limit in an attempt to reduce hot spots at the top of the equipment racks. Due to the unpredictable mixing of cool air with hot IT equipment exhaust air, a significant portion of cooling was never utilized and hours of free cooling were lost.

Husky Energy High-Density Rack Deployment

Husky Energy now knows how to manage IT exhaust heat, raise supply air temperature within the ASHRAE range, eliminate waste and gain flexibility to locate high-density IT racks anywhere on the floor.

Husky easily deployed high-density racks in quantity, anywhere on the data center floor. Placing high-density racks anywhere was not only possible, but Geist Cool's cooling distribution system also allowed full utilization of cooling resources.

Managed Cooling-Distribution Points

- All IT exhaust heat has a direct return path to perimeter cooling units
- IT equipment takes cooling from the room, regardless of cooling supply methods
- Supply air temperature has been raised to 21 ºC (70 ºF) with no hot air recirculation
- Non-uniform air delivery has no affect on room ambient or rack intake temperatures

Geist Cool Integration with Husky's Choice of IT/Building Management Software

Geist Cool software is providing real-time cooling load and environment monitoring as well as critical alarms at the management console level. IT or building management software integration was a breeze. Geist Cool SiteX View software has easy-to-use MIB and XML data and the software suite is integrated within each system microprocessor. Geist Cool systems are independent of precision cooling vendor, rack vendor, or management software platform, giving Husky the flexibility to adapt to any future need.

Managed Rack Cooling for Multiple Core Switches

The Containment Cooling system is configured to draw cool air in along the side of network switches. In the Husky configuration, two large Cisco 6509 switches are placed in 30-inch wide racks.

- Heated exhaust from network switches is directed out of the rack
- Containment Cooling system set to a slightly negative rack pressure
- Cool air enters the rack below the network switch chassis
- Cool air enters the rack at the switch side intake and ensures proper network switch operation

Husky's Ultra-Efficient Data Center

Geist Containment Cooling scales to the real-time IT load. All heat is contained and cooling distribution is managed, allowing maximum cooling efficiency and flexibility for high density computing. Husky deploys ultra-efficient servers that are designed closer to their thermal limits while still fully utilizing their cooling infrastructure, and have eliminated the need to add supplemental cooling.

The Husky Energy Data Center Project addressed three areas that impact data center spending: energy consumption, real estate utilization and operational overhead. Husky achieves 320 minimum days of free cooling while giving Operations the ability to deploy IT and maintain a safe thermal environment, regardless of rack density or placement and without any manual overhead.

Historic Building High Density Data Center Retrofit

SNL Financial

Case Study | EC8004A
Published April 2013

Transforming Traditional Office Space into a High Density Data Center with No-Raised Floor

In 2011, SNL Financial saw a diminishing return for installing additional IT equipment into their existing data center that was non redundant, had poor cooling with hot spots and no additional space. So in early 2012 they decided to build space in their existing building knowing that they wanted redundant power, N+1 cooling, an airflow management strategy, and a monitoring system that would allow them insight into the daily operation of their data center. This new data center employs cutting edge technology, design, and best practices for a 30 rack data center in a historic downtown office space retrofit.

SNL Financial

SNL Financial is the premier provider of breaking news, financial data and expert analysis on business sectors critical to the global economy: banking, insurance, financial services, real estate, energy and media & communications. SNL's business intelligence service provides investment professionals, from leading Wall Street institutions to top corporate management, with access to an in-depth electronic database, available online and updated 24/7. Uptime is critical to their system and operation.

Data Center Infrastructure

The Data Center space is a non-raised floor environment with no hot or cold aisles, and accommodates 24 Geist Cool high-density cabinets with Geist Cool intelligent-integrated power to distribute power to each cabinet. Two 77kW nominal DX CRAC units with EC variable speed fans are located around the perimeter of the room to provide cooling. In addition to these units, Geist Cool EC20R row based containment system to manage and control airflow at the rack-row level are distributed (3) per each row of cabinets. The systems will remove air from the row of cabinets at the same rate that the servers exhaust hot air. With the deployment of the Unity Cooling DCIM system the CRAC unit airflow will match the server airflow .

Data Center Design to Support Growth Initiative

"Our legacy Data Center wasn't capable of any additional power, cooling, or space expansion," said John Peterson, Enterprise IT Project Manager at SNL Financial. New space was needed to allow for additional storage, and computing with an upgraded high-speed network infrastructure. The project team began exploring many different systems and infrastructure components to accommodate the location and available space. "We knew that we wanted to do something different and had defined budget and space constraints that required us to explore a leading edge design. In addition we wanted components that could be easily serviceable and maintained by our current facility engineer's".

The implemented design is a non raised floor facility due to height of the available space located in the basement of the historic building. By choosing this modular design the space can quickly expand into the area around this space to accommodate additional cabinets and support infrastructure. In addition to the capability of quick footprint expansion or cooling and power infrastructure can also quickly expand.

> Geist Cool software is providing real-time cooling load and environment monitoring as well as critical alarms at the management console level.

SNL's Decision Criteria for Selecting Geist Cool

SNL evaluated many different options from doing in-row cooling overhead cooling, and other cooling and infrastructure methods. After receiving cost estimates for the chilled water plant, piping and other infrastructure, they determined that these other options were outside the budget. But a modular and energy efficient design were still important. "One of the benefits that Geist Cool proposed was their row-based heat containment system that would allow us to expand the airflow management, power distribution, and cabinets in a modular design," Peterson said. With the Geist Cool Dynamic containment and power at the heart of the cooling and power distribution, it was simple to also include the cabinets from Geist Cool as it is a system of components engineered to work together. And with the Unity Cooling system, all system components are brought together for an integrated view of the data center power and cooling systems.

Infrastructure Monitoring Made Easy

"We have the ability to see all aspects of our data center infrastructure through one system to measure the health of our computing facility" said Peterson. The Unity Cooling System by Geist Cool allows remote log-in to the web-based platform to be able to see the status of the facility 24/7. This is important because many of the staff at SNL work remotely or have a long distance to commute so having this knowledge to be able to act quickly and remotely is very valuable. In addition this tool provides an immediate display of where additional power is available to install new hardware.

Facility Design Benefits

- Airflow management and Cooling systems that dynamically adjust to IT load
- Automatically prevent localized hot air leakage and the contamination of cool supply air at server intakes
- Integrated system view of all infrastructure through easy to use web based DCIM platform
- Easily expandable from a power and cooling perspective to handle additional future expansion
- Accommodates both low and high density equipment in a non raised floor environment
- Allows use of standard components that SNL Facility engineers are comfortable to maintain

Geist Americas

1821 Yolande Ave.
Lincoln, NE 68521 USA
Tel: 1.800.432.3219
402.474.3400

Geist DCIM
2900 S College Ave, Ste. 2B
Fort Collins, CO 80525 USA
Tel: 877.449.4150

Geist Asia

China
Tiley Plaza Bldg A, Unit #2910,
No.199 Haide 3 Road
Nanshan, Shenzhen
Guangdong Province, China
Postal Code 518000
Tel: +86.755.86639505

Hong Kong
salesasia@geistglobal.com
Tel: +852.8176.4860

Geist Europe

United Kingdom
Unit 1, The Monarch Centre,
Venture Way
Priorswood, Taunton
Somerset, TA2 8DE UK
Tel: +44 (0)1823.275100

geistglobal.com

20000701