Frontera
Direct Liquid Cooling the World's Fastest Academic Supercomputer

CoolIT systems™

(intel)   DELLEMC   TACC TEXAS ADVANCED COMPUTING CENTER

Frontera when launched in 2018 was the fifth most powerful supercomputer in the world, and the fastest supercomputer on a university campus. It replaced the Blue Waters system as the leadership-class system in NSF's cyberinfrastructure ecosystem.

The Customer

In 2018, a new NSF-funded petascale computing system, Frontera, was awarded for deployment at the Texas Advanced Computing Center (TACC). Frontera opened up new possibilities in science and engineering by providing computational capabilities that make it possible for investigators to tackle much larger and more complex research challenges across a wide spectrum of scientific domains. Researchers today utilize the supercomputer to better understand the Covid-19 virus, tornado formation, new drug discoveries, among other topics.

Customer Challenge

While the Frontera supercomputer opened up new possibilities in science and engineering for years to come, it's challenge would be cooling this new system with the pre-existing air-cooling infrastructure in the facility. As Frontera would be 3x times denser than Stampede 2 and air cooling would not be sufficient to cool the high-powered CPUs, the TACC Frontera team turned to CoolIT Systems to deliver a high-density liquid cooling solution.

CoolIT Systems Solution

Using highly efficient Direct Liquid Cooling (DLC) technology, CoolIT Systems designed a Rack DLC solution to meet Frontera's needs. Frontera contains 8,008 liquid-cooled Dell PowerEdge C6420 servers across 91 racks. The liquid is managed by 9 CoolIT CHx750 coolant distribution units (CDU) which are connected to a custom CoolIT secondary fluid network installed under the floor. This CDU network manages over 5.2 megawatts of the Intel Xeon CPU heat.

Customer Benefits

With a successfully installed CoolIT Systems Rack DLC solution, Frontera draws on the power of over 16,000 processors and 448,448 cores spread over 8,008 compute nodes to achieve a peak performance of 38.7 PetaFLOPS. According to TACC, to match what Frontera can compute in just one second, a person would have to perform one calculation every second for about a billion years.

This peak performance will help researchers blaze new paths to discovery in virtually all fields of science, from astrophysics to zoology. Some of the initial projects running on Frontera are focused on understanding the influence of distant stars, eradicating emerging viruses, diagnosing and treating brain tumors, and creating a new generation of flexible solar photovoltaics.

"Without Direct Liquid Cooling and the resulting performance increases, Frontera would not have been able to achieve the #5 ranking on the Top 500 list."

-Nathaniel Mendoza, Manager, Networking, Security & Operations, Texas Advanced Computing Center

CoolIT Systems Rack DLC solution for Frontera is a flexible, modular installation that includes:

Passive Coldplate Loops

The Dell PowerEdge C6420 server CPUs are cooled by CoolIT Passive Coldplate Loops. Each Passive Coldplate Loop terminates in a Stäubli dry-break quick disconnect, allowing for safe and simple removal of servers from the cabinet during server maintenance.

Rack Manifolds

A pair of vertical manifolds are installed at the back of each rack, to interface between the Passive Coldplate Loops and the Secondary Fluid Network under the subfloor. This allows simple decoupling of a single server without the need to remove a neighboring system by way of the quick disconnects.
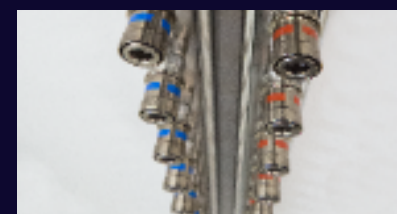
Coolant Distribution Units (CDU)

The entire CoolIT liquid cooling system inside Frontera is managed by 9 row-based CHx750 CDUs which circulate coolant through the Secondary Fluid Network, racks and servers and reject this energy to a facility water feed connected to the facilities water treatment center.

Rear Door Heat Exchangers (RDHx)

With DLC components managing over 70% of the server heat through liquid cooling, 91 RDHx provide air cooling for the remaining heat. These RDHx operate in series to the DLC components utilizing the same liquid supply for efficient cooling.

Secondary Fluid Network (SFN)

Frontera is separated into 3 rows of 30 data center racks, with each row being coupled to 3 CHx750 CDUs via a secondary fluid network. This network of CoolIT Systems installed sub-floor pipes connects the CDUs directly to the RDHx and Rack manifolds to provide a constant supply of treated PG25 coolant.

HPC Setup

- 8,008 direct liquid cooled Dell PowerEdge C6420 servers across 91 racks
- 9 CoolIT Systems Rack DLC CHx750 CDU's
- 91 stainless steel 54U Rack Manifolds, featuring dry-break quick disconnect technology
- 91 Rear Door Heat Exchangers
- 3 subfloor secondary fluid networks

Results

- 5.5 MW total heat load managed
- Significantly lowered data center OPEX
- Continued utilizing existing data center building
- Reduced noise pollution