TES Tanks Prove Effective in Cooling System Design

October 2024

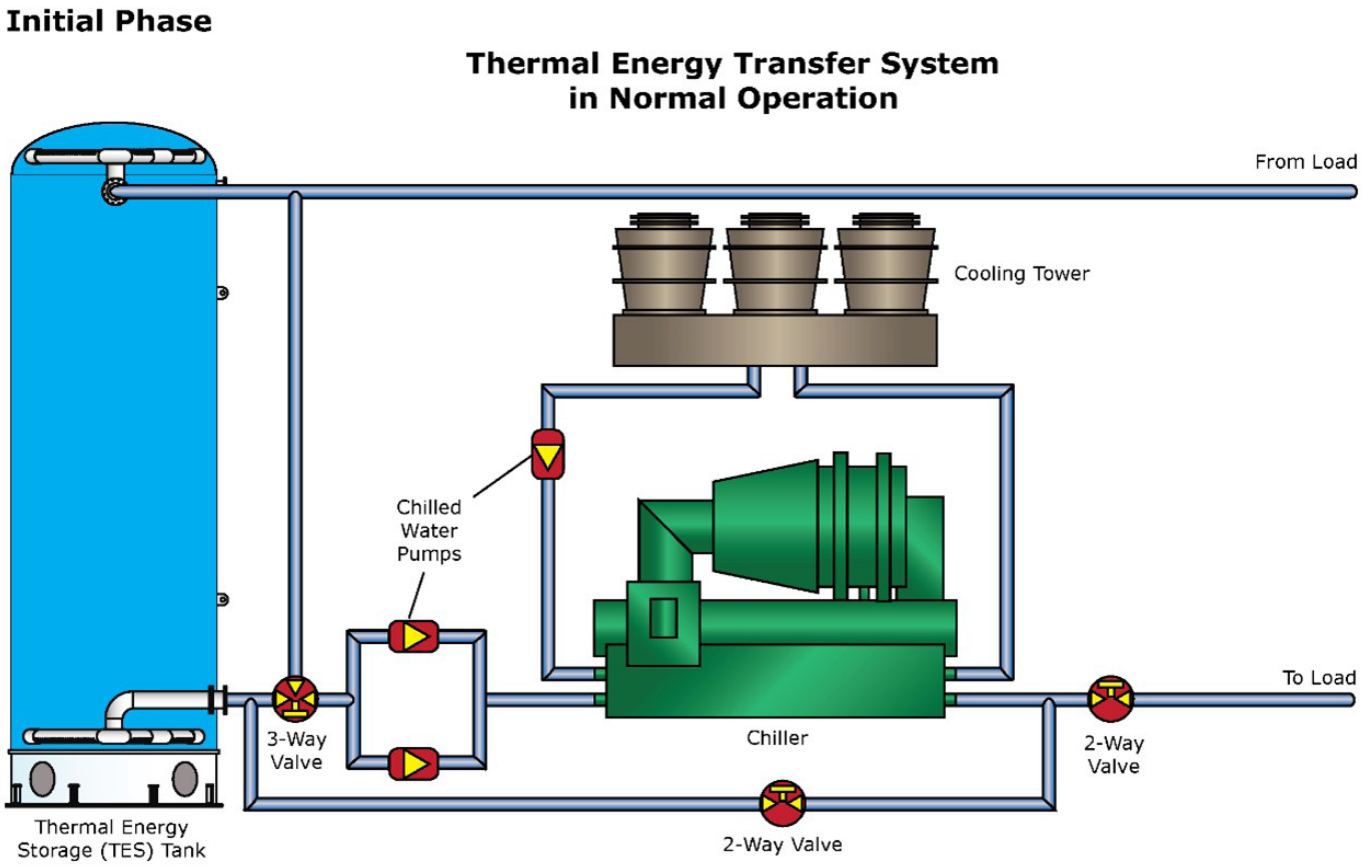

Figure 1.

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THERMAL ENERGY STORAGE TANKS CRITICAL FOR COOLING DATA CENTERS

The US technology industry revolves around the ability to store and maintain data. This data has become a valuable resource for companies as it represents our personal and business intelligence. Mobil technology has increased the need for cloud and AI based storage as smart devices learn from user behavior and become more efficient.

The ability for platforms to collect, analyze, and interpret our data allows for better decision-making and creates predictive analytics.

This massive uptick in technology has led to an urgent need for more data centers. These gigantic facilities house the servers, routers, network equipment, storage devices, firewalls, cooling systems, uninterrupted power supply (UPS) and generators. Data centers operate 24/7/365 and require massive amounts of resources to include water to operate.

The US is a global leader in the data center industry with over 5,300 facilities across the country. With AI leading the charge in today's digital world, the need for updated and new data centers has increased exponentially.

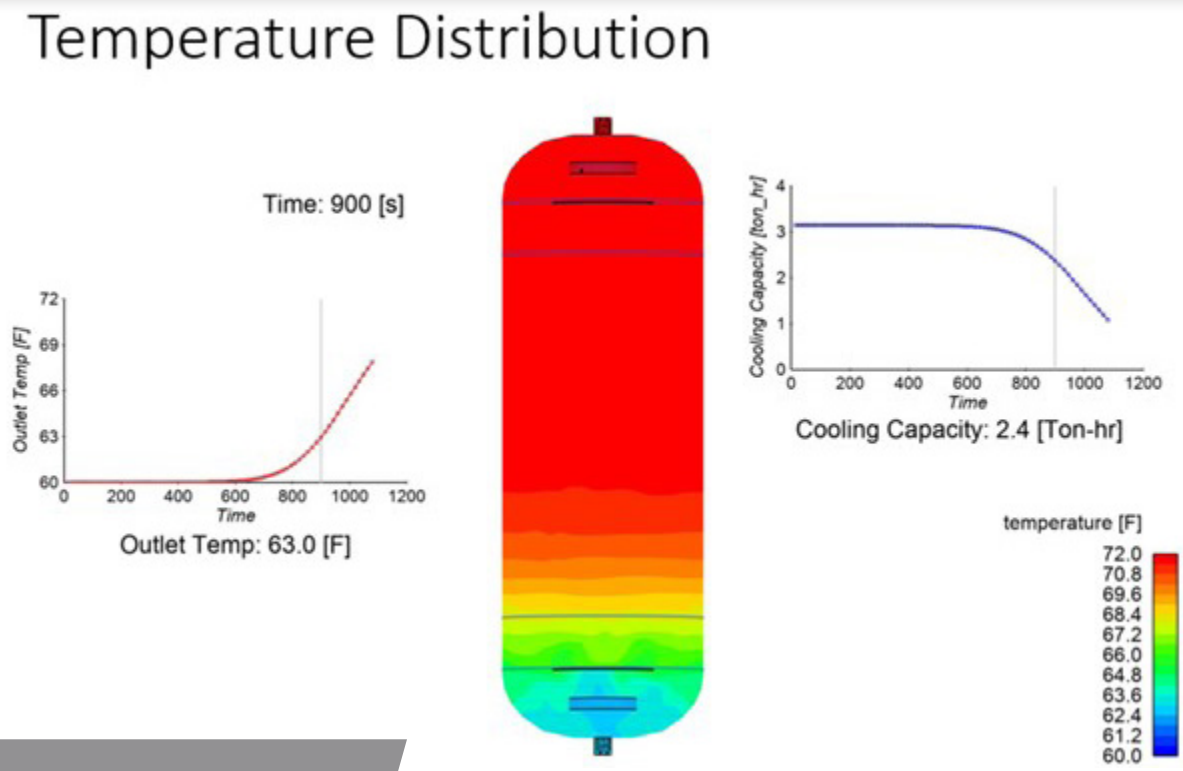

Figure 2.

With the increase in demand of high efficiency computing comes an increase in their environmental footprint. With the increase in accuracy comes an increase in cooling capacity as servers are consistently operating at much high loads.

These operating conditions create risks calling for both primary and redundant cooling systems to dissipate heat generated by the servers and other data center equipment. Data centers use two types of cooling: water and air. Water cooling uses water in different forms, such as chilled water systems and/or cooling towers to absorb and remove heat from servers, networking equipment and power supplies.

Chilled water systems, or Thermal Energy Storage (TES), are the most common in the data center world as it is the least expensive cooling system to operate and maintain.

In a chilled water system, a central chiller(s) is used to cool water to the desired temperature as it circulates through the cooling infrastructure. Once the chilled water reaches the load, energy is expelled in the form of heat which is absorbed in the cooling loop. This cooling loop interaction creates a delta between the discharged cooling temperature and the heated return temperature. This delta (ΔT) dictates the efficiency of the chilled water system and its effectiveness in managing the high heat conditions. That being said, redundancy in a chilled water system is a necessity that cannot be overlooked (see Figure 1 on page 1).

If power is interrupted for more than a few seconds at a mission critical facility, like a data center, the ability to cool the computing equipment is jeopardized and could lead to imminent failure of critical electronic components. Electronic components found in large servers do not like heat and will fail with linear increases in temperatures in a short duration. Planning for a potential loss of cooling system capacity, although rare, is essential in the maintaining the integrity of our storage information. Thermal Energy Storage (TES) is a key element in delaying the effects of cooling failure due to power loss and/or catastrophic failure. TES allows time for system repair, delay in start-up, or the time it takes the back-up generators to come on line.

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Tank Design:
Highland Tank has been supplying the mission critical and HVAC industry with high performance TES systems for the last 20 years. Chilled water TES is normally a cylindrical designed, vertically configured pressurized water tank. Tank construction follows ASME steel fabrication standards as well as AWWA D102 standards for interior and exterior corrosion control coatings.

The exterior tank is configured with factory or field-applied closed cell foam at a minimum 2" (R-12.5). Insulation is important on a TES tank as the ratio of storage volume to surface area is relatively high. Insulation aids in maintaining the temperature differential within the tank and reduces the unusable volume during discharge cycle.

To maintain the efficiency and meet the required cooling duration complex predesign techniques to include CFD modeling are required. CFD has become, in a short period, an integral tool of the engineering design and analysis environment for our TES systems because of its ability to predict the performance of new designs or processes before they are manufactured or implemented (see Figure 2 on page 2).

CFD allows Highland Tank to dial in the process of stabilizing the two separate densities of water with minimal mixing and thermal conductance

The cost savings for energy use and consumption can be exponentially reduced by using CF modeling.

Conclusion:
TES is proven to be attractive when new investments in chiller plants are required. The need for back-up and/or redundant systems in time of need at mission critical facilities makes a chilled water storage tank the most economical invest in cooling system design.

Environmental benefits include reduction of source energy use, decreased refrigerant charge, and improved efficiency of the energy supply. Because the TES is constructed of durable materials, like steel, life cycle costs are at a minimum. Contact Highland Tank for more information.

Call 814-893-5701 or visit us at www.highlandtank.com for more information.

Contact: Michael Gauthier
Email:
mgauthier@highlandtank.com

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