

Johnson Controls® BlueStream™ Hybrid Cooling Systems

In Data Centers.



Optimizing Resource Management



A More Resourceful Solution To Data Center Operational Challenges

Introducing The BlueStream™ Hybrid Cooling System



The demand for digital capacity continues to grow at an explosive rate – and with it, the demand for new data centers. Plus, servers and other electronic components within these centers are operating at increased temperatures. This escalating thermal load requires increased cooling capacity and efficiency at all hours of the day, night and weekends, and reliability of the cooling system is critical to uptime, continuity of operation and protecting expensive hardware.

Water-cooled systems do a great job of efficiently handling the high heat-rejection requirements of a data center. Unfortunately, continuing droughts and global warming are limiting the availability and raising the cost of makeup water used in cooling towers in many regions. Water-cooled systems also generate a large wastewater stream to mitigate buildup of solids in the circulating condenser water loop, an issue when municipalities limit allowed wastewater discharge.



Permitting can be a major issue blocking new installations in water-constrained areas. The alternative to using air-cooled heat rejection systems can be cost-prohibitive, as it requires massive units that are considered far less efficient than evaporative cooling for heat rejection.

Fortunately, there's a better solution: a BlueStream hybrid cooling system that optimizes use of two cooling technologies in a single operating system. Used in conjunction with a traditional cooling tower, the BlueStream hybrid cooling system can reduce water consumption by up to 80%. It is highly effective across a vast range of weather conditions, as it automatically modulates to utilize the most efficient combination of water- and air-cooled systems (both individually and simultaneously) in response to utility rates, temperature and load demand. The system's modular design is highly scalable, with the ability to add multiple units in parallel to handle the largest cooling requirements. Key core technology within the BlueStream hybrid cooling system is the Thermosyphon cooler, a dry-heat rejection designed to work as a complement to your cooling tower system.

The BlueStream hybrid cooling system lets you manage both natural and financial resources with tremendous efficiency. It is equally cost-effective when building a new data center or retrofitting a facility experiencing restricted water resource issues.

Optimized Efficiency:

The BlueStream Hybrid Cooling System

At Johnson Controls, we are passionate about water conservation issues. Finding new ways to be more efficient in the use of this precious natural resource is a priority for us and the customers we serve. Our patent-pending BlueStream hybrid cooling system reduces water use by as much as 80% while minimizing operational costs.

The BlueStream hybrid cooling system adds a dry cooling system to your existing wet system, then coordinates the operation of the two for optimum efficiency, utilizing wet cooling when it's hot and dry cooling when it's not. Intelligent controls allow a combination of the two to run simultaneously in all weather conditions between the two extremes.

Its modular design allows this system to be scaled up to handle the largest of facilities in the most extreme environments.

The system utilizes the Thermosyphon cooler, a dry-heat rejection unit that can be used in an open cooling tower loop or as a dry waterside economizer. Refrigerant circulates naturally through the Thermosyphon process, with no need for a pump or compressor. Freeze protection is accomplished by controlling the refrigerant flow. This system is designed for low maintenance, with an easily cleanable low pressure drop heat exchanger.

Additional advantages include:

- Highly efficient contact with open cooling water
- Low waterside pressure drop (1-4 psi)
- A "W Coil" 12-fan design that allows minimal spacing between adjacent units, reducing plan area requirements
- Smaller installation space and lower relative cost compared with those of competitive units

Compatibility with an existing condenser water system is easily achieved, as evaporator tube metals can be cost-effectively substituted at the design phase before manufacturing. Alternative metals include CUNI, stainless steel or titanium.

Optimizing Resource Management

Measuring Cost-Effectiveness: The WECER Ratio

To fully appreciate the potential operational savings of the BlueStream hybrid cooling system, you have to balance water and energy usage costs. This is expressed as the Water-to-Energy Cost Equivalence Ratio or WECER. Simply put, WECER is cost of water (\$/1,000 gallons) divided by cost of electricity (\$/kWh).

Figure 1 at the right shows peak and annual HVAC Partial Power Usage Effectiveness (Partial PUE) and the HVAC Partial Water Usage Effectiveness (Partial WUE) ratios for several different types of HVAC systems applied to a 16 MW data center that was modeled for the Dallas, TX climate. This advanced data center is being designed with a 60° supply water temperature to the CRAH units. Both the peak hour and the annual average partial PUEs are read on the left vertical axis, while the partial WUEs are read on the righthand vertical axis. The lefthand group represents a standard air-cooled chiller system design, while the right hand group represents a standard water-cooled chiller system design. The center group of data represents the performance of the BlueStream hybrid cooling system.

Table 1 compares several key system metrics to the base water-cooled system design. As can be seen, the BlueStream hybrid cooling system not only saves over 25% of the annual water use, but also results in a net reduction of overall data center energy as, indicated by a reduction in the annual HVAC partial PUE of 4.4%. For this particular data center, the combined HVAC energy, and water operating cost savings exceeded \$470,000/ year compared to the base water-cooled chiller system and over \$610,000 compared to the air-cooled chiller system.

The key to resource management is our BlueStream hybrid cooling system, which can be set for either maximum operating savings based on your WECER, or maximum water savings of up to 80% while maintaining peak output.

Flexibility and Functionality

A BlueStream hybrid cooling system can be incorporated incrementally into an existing facility without greatly modifying the existing infrastructure and with minimal disruption to data center operations.

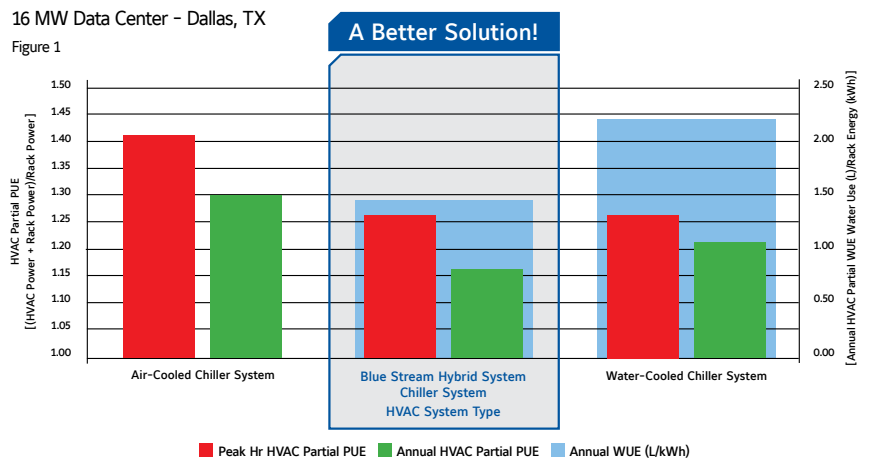


Table 1

System Metric	Air-Cooled System	Compared to Water-Cooled System	Blue Stream Hybrid Cooling System	Compared to Water-Cooled System	Water-Cooled System
Peak Hr HVAC Partial PUE	1.406	+11.5%	1.262	+0.1%	1.261
Annual HVAC Partial PUE	1.298	+7.1%	1.159	-4.4%	1.212
Annual WUE	\$0.000	+100%	1.445	-25.9%	1.949

A Global Leader in Controls Technology

Johnson Controls provides expert assistance at every stage of your project, from overview, design and manufacturing to installation, training and maintenance support functions. Visit www.johnsoncontrols.com/bluestream for more information.



No need for antifreeze; freeze protection is accomplished by controlling refrigerant flow

High-efficiency premium variable-speed fans

Uses natural Thermosyphon effect to circulate the refrigerant; no intermediate pump required

Freeze-protected single-pass condenser

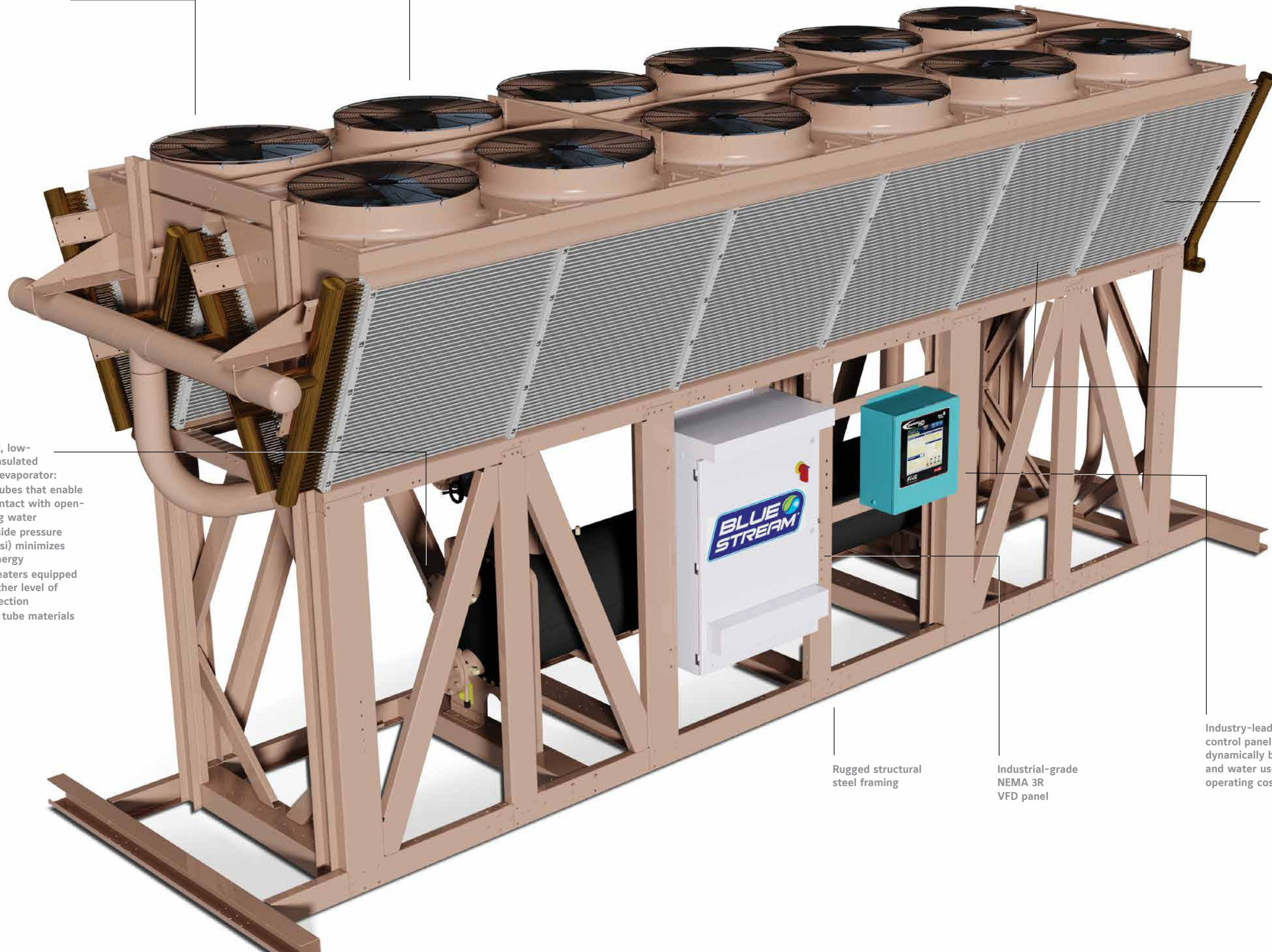
Highly efficient, low-maintenance insulated shell and tube evaporator:

- Cleanable tubes that enable efficient contact with open-loop cooling water
- Low waterside pressure drop (1-4 psi) minimizes pumping energy
- Auxiliary heaters equipped to add another level of freeze protection
- Alternative tube materials available

Rugged structural steel framing

Industrial-grade NEMA 3R VFD panel

Industry-leading Quantum™ HD control panel designed for dynamically balanced energy and water use to optimize total operating cost



Better Resource Management Through Hybrid Technology



Our BlueStream hybrid cooling system combines air-cooled and water-cooled heat rejection systems with advanced controls, reducing water usage by up to 80% while optimizing efficient energy use. Excellent for either new or retrofit applications.



Power Generation Plants



Central Chiller Plants



Petro/Chemical Manufacturing Plants

Warranty and Support


Johnson Controls supports customers at thousands of worldwide locations with full parts and service capabilities to provide exceptional responsiveness.

Contact Us for a Quote

For a quote or further information about the BlueStream hybrid cooling system, please email BE-Bluestream@jci.com.

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