Johnson Controls

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SPECIFICATIONS

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BlueStream™

HYBRID COOLING SYSTEM

FEATURES AND BENEFITS

The BlueStream Hybrid Cooling System (HCS) is an advanced cooling system which uniquely and cost effectively combines and integrates the control of an innovative dry heat rejection device, the thermosyphon cooler (TSC), with a conventional evaporative wet heat rejection device, an open cooling tower.

This new heat rejection system, a combination of equipment and controls, enables significant annual water savings to be achieved in comparison with traditional "all evaporative" heat rejection systems while maintaining the maximum peak process output and energy efficiency on the hottest summer days. The BlueStream HCS embraces the "smart use of water", using evaporative cooling when it is most advantageous and then saving water and modulating towards increased dry sensible cooling as process requirements and ambient weather conditions permit.

Innovative fan control strategies for both the dry and evaporative heat rejection devices assure the most economical balance between water savings and parasitic fan energy.

The BlueStream HCS can be controlled to minimize overall utility costs, insuring the cost of the water saved is greater than the cost of the additional fan and pump energy of the TSC unit. The annual operating cost of the system will thus be lower than what would have been possible with the cooling tower only system.

Key Features

- No intermediate fluid pump required
- Uses natural circulation of refrigerant
- No need for antifreeze
- Freeze protection achieved by controlling refrigerant flow, evaporator insulation, and evaporator heaters
- Low waterside pressure drop to minimize pumping energy
- Cleanable heat exchanger
- Enables direct contact with open cooling water
- Control system modes:
  - Minimum operating cost mode provides a balance between water and energy use
  - Maximum water saving mode

BlueStream Hybrid Cooling System Applications

Any heat rejection applications which have traditionally made use of cooling towers can be considered as viable candidate applications for the BlueStream HCS.

These include:

- Process Cooling
- Data Centers
- HVAC Applications with Water Cooled Chillers
- Power Generation

The BlueStream HCS can be applied in new facilities or applied as a retrofit solution for existing facilities. In retrofit applications on existing cooling tower systems, the existing cooling towers can be retained as the evaporative heat rejection portion of the BlueStream HCS solution.

The BlueStream HCS can typically drive annual water consumption savings of between 30% and 80% in comparison to a traditional "all evaporative" open cooling tower system. Key variables which will impact application specific water savings will include annual load profiles, process temperatures, weather conditions, and the quantity of TSC units installed.

Thermosyphon Cooler (TSC)

The thermosyphon cooler (TSC) is the heart of the BlueStream HCS. The TSC unit is a packaged dry heat rejection device supplied with piping, valves, controls, and instrumentation. The unit is also supplied with an enclosed VFD drive for powering the fans.

A Quantum™ HD local control panel, provides the controls and logic for operating the unit and will act as an integration point for the site control system. The TSC employs a naturally recirculating refrigerant loop to convey heat from its evaporator to its air cooled condenser.

The unique design of the TSC allows open cooling water to be cooled directly by the easily cleaned, low water pressure drop TSC evaporator without risk of bursting tubes in sub-freezing ambient conditions. Separating the water to refrigerant heat transfer in the TSC evaporator from the refrigerant to air heat transfer in the TSC condenser allows the design and metallurgy of each device to be optimized for its specific purpose.

The TSC can also be applied directly in a primary cooling loop as a dry waterside economizer.

The evaporator is a tube and shell style flooded evaporator with the refrigerant on the shell side, and the water on the tube side. It is constructed, tested, and stamped in accordance with applicable sections of ASME pressure vessel code.

The evaporator is provided with vent and drain fittings, and is insulated with heaters controlled for freeze protection. It has a very low water pressure drop to minimize the pump energy. Copper tube material is standard while other tube materials are optional. In standard two pass arrangement, the water inlet and outlet connections are fitted with 6" 150# class flanges.

The condenser is an air cooled single pass tube-fin condenser supplied with an enclosed VFD drive for powering the fans and fan speed control. The coils are internally enhanced, seamless copper tubes, mechanically expanded into aluminum alloy fins with full height collars. It consists of four condensing coil banks in two V-shaped arrangements.

The power for the unit is provided through a single 460V/3PH/60HZ power connection located in the VFD panel.

Control: The factory supplied Quantum HD local control panel is NEMA 4 rated and built to the UL-508A standard. It provides the controls and logic for operating the unit and will act as an integration point for the site control system. The Quantum HD panel is installed on the lead TSC in each group. One Quantum HD control panel supports up to 16 TSC units in a group. A PLC control option is also available upon request.

It is factory wired with all the factory installed safety, operating, and monitoring devices including control of packaged valve, heaters, fan motors and their speed, water inlet and outlet temperatures, ambient dry bulb temperature and relative humidity sensors. Field installed sensors and control signals are wired (by others) to the Quantum HD control panel. Communication between multiple units uses Modbus protocol via RS-485, wired by others.

Three field-selectable serial communication ports allow you to choose from a combination of RS-422 or RS-485 port configurations for external communications using MODBUS ASCII, MODBUS RTU, or Allen-Bradley DF1 protocols. Additionally, an Ethernet port allows Ethernet and Internet communications using MODBUS TCP, Allen-Bradley Ethernet I/P, or HTTP protocols.

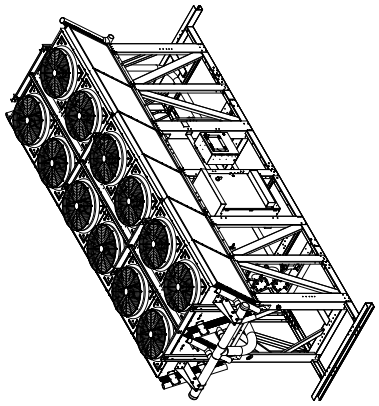
Operating Modes

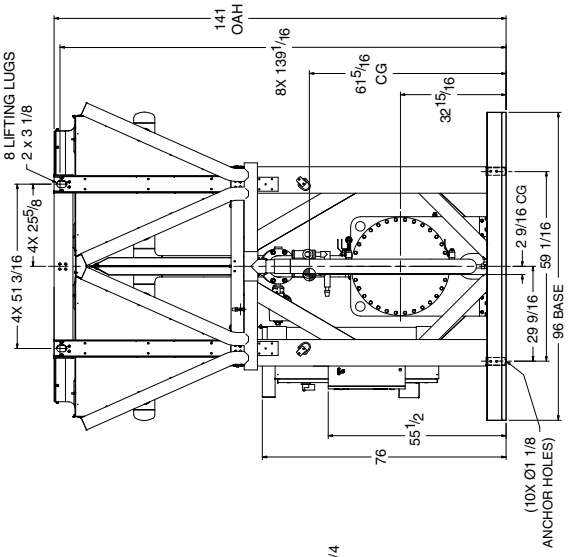
The control logic provides two main operating modes:

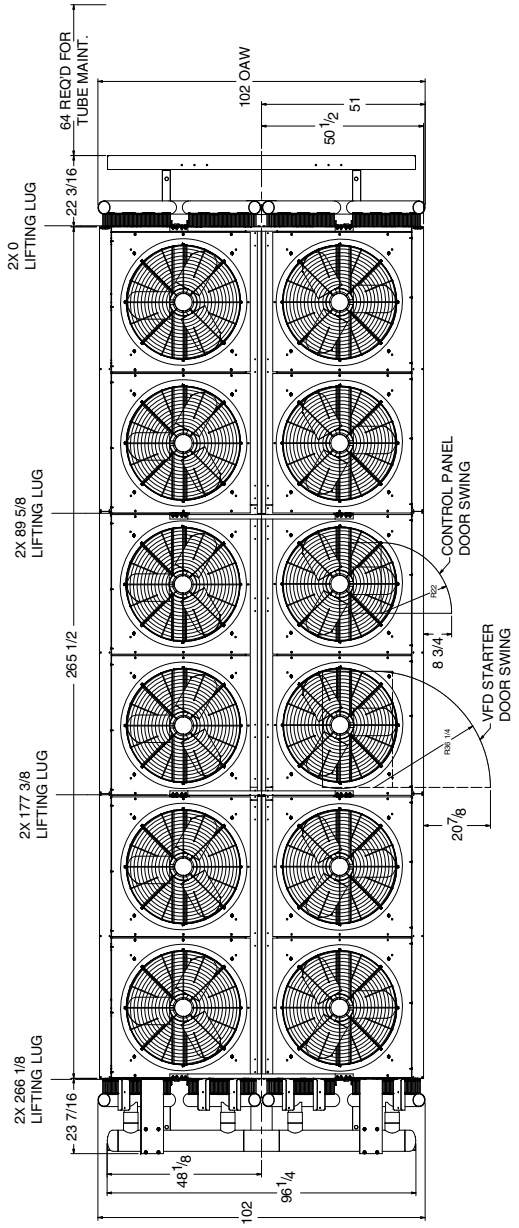
- Minimum operating cost mode
- Maximum water saving mode

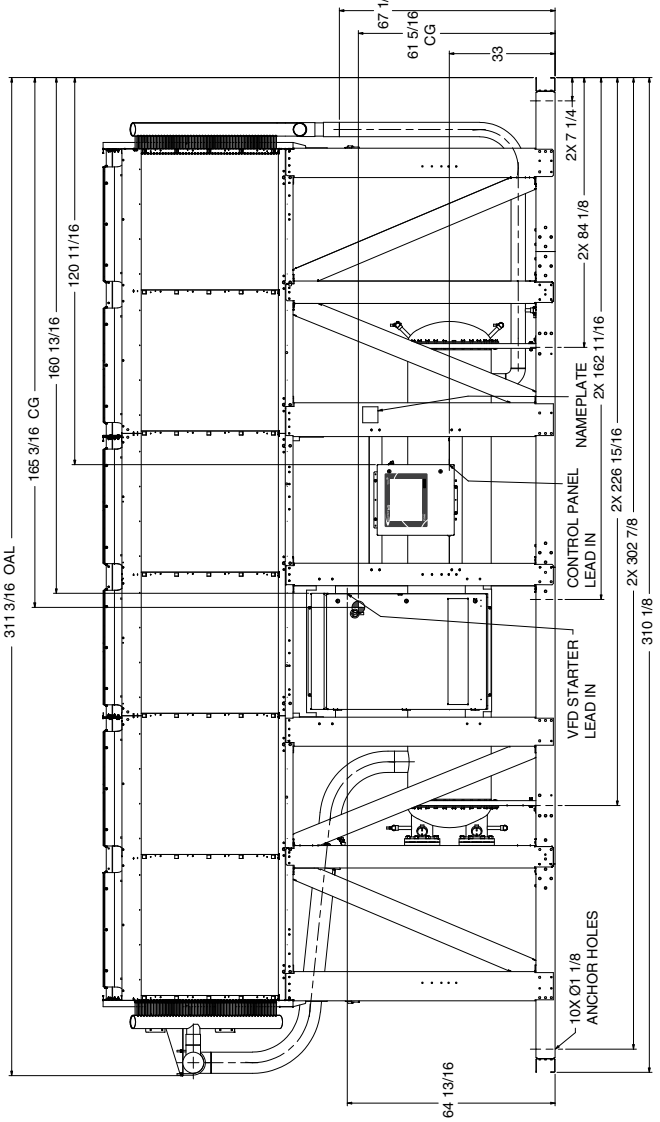
With the minimum operating cost mode, the system automatically balances the energy and water uses to yield the lowest system operating cost. With the maximum water saving mode, the system will use the least amount of water by maximizing the dry heat rejection operation.

THERMOSYPHON COOLER (TSC) STANDARD DESIGN









TSC TECHNICAL SPECIFICATIONS

Nominal Capacity

Each single thermosyphon cooler (with standard copper evaporator tubes) provides up to 386 refrigeration tons (TR) of cooling capacity with 95°F entering water/85°F leaving water at a 40°F ambient DB temperature. Water circuit pressure drop through the unit is 4 PSID at 600 GPM in a two pass configuration. Modular design enables flexible Implementation in any quantities: any number of TSCs can be bundled together to meet any desired water savings target. Depending on the application, each TSC unit can provide 1 to 5 million gallons of water savings per year.

Dimensions & Weights	
Shipping Dimensions	26' L x 8.5' W x 12' H
Shipping Weight	16,200 lb (approx.)
Operating Weight	17,550 lb (approx.)
Refrigerant Charge	Pre-charged with 1,200 lb of R-134a
Pressure & Power	
Max. Design Pressure	235 PSIG / 16 BARG
Flow Range	200 – 1,200 GPM (two pass) 400 - 2,400 GPM (single pass)
Voltage	460V / 3PH / 60 Hz (US)
Max. Inlet Water Temp.	Limited to 125°F
Max. Total Fan Power Consumption	22 kW (full fan speed with controller) 21.7 kW (without controller)
Max. Control & Heater Pwr. Cons.	2.5 kW

Materials & Sensors	
Evaporator Tubes	Standard: Copper tubes (Optional materials available)
Fans	(12 qty) fans per unit
VFD	(1 qty) enclosed VFD for powering fans and speed control
Evap. Heaters	(2 qty) 1 kW each
System Sensors *(Per Group - Up to 16 TSCs per group)*	
Entering Water Temp. Sensors [1]	(1 qty standard) RTD type, 4-20mA (2 qty optional)
Leaving Water Temp. Sensors [1]	(1 qty standard) RTD type, 4-20mA (2 qty optional)
Ambient Dry Bulb Temp. Sensors	(2 qty) RTD type, 4-20mA
Relative Humidity Sensor	(1 qty) 4-20mA
TSC System Flow Meter (Optional)	(1 qty) 4-20mA
TSC Run Permissive	(1 qty) Digital Input
TSC Flow Enable	(1 qty) Digital Output
System Alarm	(1 qty) Digital Output
Evaporator Sensors *(Per TSC)*	
Leaving Water Temp. Sensors	(1 qty) RTD type, 4-20mA
Evaporator Pressure Sensor	(1 qty) 0 - 300 PSIA, 1 - 5 VDC

1. Field installed by others

TSC HEAT REJECTION PERFORMANCE EXAMPLE

TSC Heat Rejection Capacity:

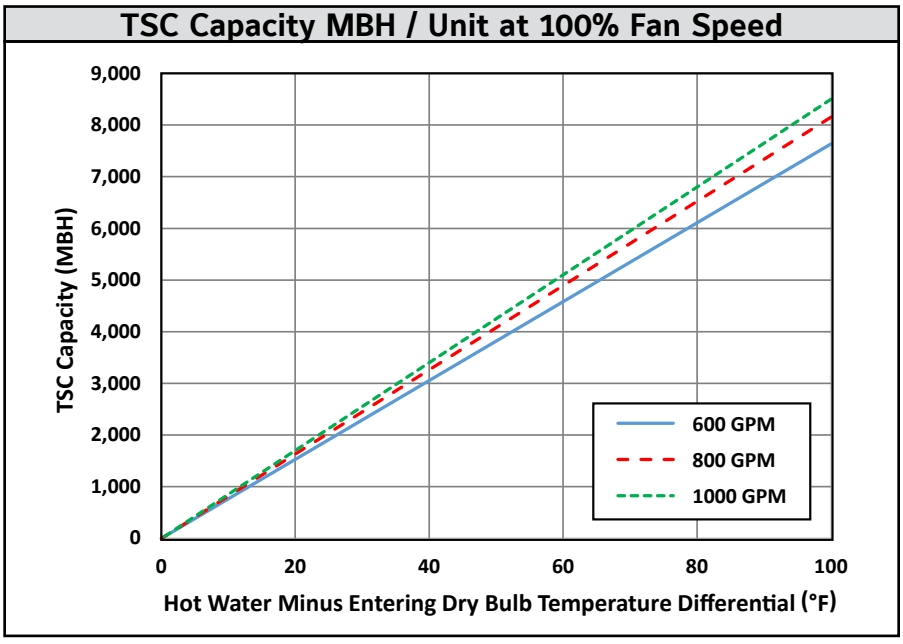
The following example, under the maximum water saving mode, shows the –

TSC heat rejection capacity

vs.

the temperature differential between the entering hot water and the ambient dry bulb temperature (the approach) at three different water flow rates:

600, 800, and 1,000 GPM.



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Johnson Controls

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