Cooling Tower Case Study

Hyde Collection Museum

Case Study No. 26

"Tower Tech covered all of our facility's priorities. We reduced our electrical demand by 30% and we are now able to shut off our chillers from October to April, when, in the past, we ran them year round."

– Keith Jablonski
Facilities Manager
The Hyde Collection

Project Overview

Keith Jablonski, Facilities Manager and Director of Engineering at The Hyde Collection, knew he had to replace the facilities two Baltimore Aircoil® (BAC) 50-ton closed circuit water coolers (CCWC), which had fan motors with a combined 20 HP. The outdoor environment of the facility is harsh due to its close proximity to a large pulp mill. The prevailing winds put the BAC units downwind of the mill, which necessitated constant cleaning of the units. This environment caused the units to deteriorate rapidly, produce continuous leaks, and require excessive maintenance.

The Hyde Collection called on the its long-term mechanical service company, **Technical Building Services, Inc.** (TBS) of Ballston Spa New York. TBS is an HVAC mechanical service company as well a building automation/energy management system provider. **Ed Galarneau of TBS** discussed the project with The Hyde Collection and a list of the facilities' priorities was produced.

Priorities:

1 – Maintain interior space conditions to protect the priceless art collection.
2 – System redundancy.
3 – Increase longevity in regards to outdoor environmental conditions.
4 – System must be easy to maintain, energy-efficient and allow growth potential, all of which fulfill the requirement of good stewardship of contributors' dollars.

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Cooling Tower

Hyde Collection

Cutaway view
of a Tower Tech TTXE
Series 4-fan cooling tower module

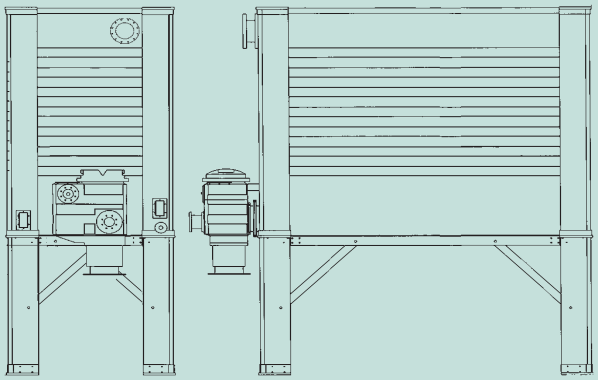
TBS was familiar with Tower Tech cooling towers, but was going to rule them out because they are not closed circuit water coolers. TBS contacted **Ray Hickey of Advanced Comfort Systems, Inc.** (ACS), the local Tower Tech manufacturer's representative, to see if ACS had a solution. ACS reviewed the predefined priorities and immediately responded that Tower Tech meets them all.

The two existing BAC CCWC were piped independently to the two 40-ton Carrier® reciprocating chillers. The BAC CCWC also were set up to provide "free cooling" through a plate and frame heat exchanger. A 40% propylene glycol solution runs through the condenser loop and up to the plate and frame exchanger. There is a requirement for cooling 24/7. The existing system ran the chillers anytime the outdoor ambient was below 30°F, and utilized "free cooling" below 30°F ambient.

The facility is required to maintain space conditions of 70°F and 50%RH. Local area design conditions are 90°F dry bulb and 75°F wet bulb for summer conditions and -25°F dry bulb winter conditions. The two Carrier® 40-ton chillers required 120 GPM each

Cooling Tower Specifications:

- Tower Tech Modular Cooling Tower™ (Model TTXE-021930)
- Tower Tech 6' High Sub-structure (FRP & 304 Stainless Steel Hardware)
- Tower Tech Rotary Spray Nozzles™ (3:1 Turndown Capability with Hydraulically Uniform 6' x 6' Square Spray Pattern)
- Tower Tech Fan Motor Control Panel with Temperature Controller (460V, UL-Rated, NEMA 4)
- U.S. Electrical Motors (TEAO, 460V, 5.6 Amps, 213T Frame, 82.5% Efficiency, Inverter-Duty, Class "F" Insulation, L_{10} Sealed Bearings)
- Multi-Wing Fans (Direct-Drive, Model 7WR, 4 Blades)
- Individual Rotary Disconnects (UL-Rated, NEMA 4X)
- Factory Pre-wired (Shielded 12-4 AWG Oil Resistant Flexible Cable)
- Tower Tech Stainless Steel Fan Motor Support
- Brentwood Industries CF 1900 Fill Media



Cooling Tower Design Conditions:

- Brentwood Industries CDX 80 Drift Eliminators (High Efficiency)
- Flow Rate (GPM): 625 Max/200 Min
- Entering Water Temperature (HWT): 95° F
- Leaving Water Temperature (CWT): 85° F
- Entering Wet Bulb Temperature (WBT): 76° F

Case Study

Museum

at 85°F entering water and TBS decided that instead of the chillers having their own independent cooling tower they wanted one cooling tower system for a combined maximum flow of 240 GPM while leaving the existing plate and frame heat exchanger in place for free cooling.

ACS was asked to provide a proposal and in doing so selected a Tower Tech Model TTXE-021930 with two 3HP fan motors. It fit all of the facility's priorities by providing:

1 – Tower reliability.

2 – Tower redundancy, accomplished with two cells and two fan motors.

3 – Built to withstand the harsh environment; FRP construction and stainless steel hardware.

4 – Easy to maintain. Tower Tech's patented bottom-mounted fans, self cleaning Rotary Spray Nozzles and Water Collection System reduce maintenance and fan HP and provide unmatched energy opportunities.

The challenge for TBS was to install the new tower during the height of the summer cooling season. With a facility containing priceless art, work could not begin without proper space conditioning. The restrictive work area would not allow the use of temporary cooling equipment, so **Tim Devine, TBS's Project Manager**, determined the change-out had to be completed in eight hours or less. TBS decided, based on Tower Tech's compact design, that they could leave one of the BAC CCWC in operation during the transition.

TBS deep cooled the facility, prepared all of the electrical, piping and direct digital controls, and completed the changeover in eight hours. The glycol was drained from the system and replaced with water to increase the heat transfer efficiency, reduce condenser pump HP, and rid the system of the glycol feeding and maintenance.

TBS is a TAC independent field office and they install web-based direct digital controls (DDC). TBS had existing controls in the facility so they chose to build their own tower control panel. **Jim Price, TBS's DDC Engineer**, reviewed the typical Tower Tech control sequence with ACS and created the following sequence of operation.

SEQUENCE OF OPERATION

General

The Tower Tech cooling tower will remain in operation year-round. Cooling tower water will be controlled to maintain not less than 70°F when in chiller mode and will attempt to maintain 45°F when in "free cooling" mode. The cooling tower is equipped with two low ambient basin heaters that have their own sensors and controller. A variable-frequency drive will modulate tower fan speed to maintain tower leaving water temperature at the set point. The cooling water recirculation pumps will be cycled to maintain required flow to the cooling tower spray nozzles.

Safety

The cooling tower is equipped with low ambient basin heaters. The heaters will be wired to an existing Emergency Power Panel to assure operation in the event of power loss. Also, a flow switch will be installed in the inlet water piping to prevent the basin heater element from energizing when water is flowing through the tower. The tower leaving water temperature will be monitored and an alarm will be generated if the leaving water temperature falls below 40°F.

An ultrasonic water level sensor will be installed to monitor water level to determine if the tower's cold water basin water level is remaining between 7' and 9". An alarm will be generated by the building management system (BMS) any time the water level is outside these parameters.

Anytime the pumps run status fails to match the enable command, the lag pump will be enabled and an alarm will be generated by the BMS.

Free Cooling Mode

Free cooling mode will be utilized any time the cooling tower can provide a leaving water temperature of 55°F or less. In free cooling mode the tower fans' speed will be modulated to maintain the desired discharge temperature and the recirculating pumps will be cycled to maintain tower cooling capacity. On a call for cooling, the valves to the heat exchanger will open for flow through the heat exchanger, the valves to the chillers will be closed to flow through the chiller, and the cooling tower by-pass valve will be open to flow through the cooling tower. The lead cooling tower circulation pump will be enabled and once flow is established the chilled water pumps will be started. The cooling

tower fans will be enabled when the leaving water temperature rises above 50°F and will be modulated to maintain a tower leaving water temperature set point of 45°F. As the leaving water temperature drops below 45°F, the cooling tower will modulate towards the cooling tower by-pass position. Free cooling mode will be utilized until the leaving water temperature cannot be maintained at or below 50°F for 30 minutes with both recirculating pumps running and tower fans at 100% speed output. When this occurs, the cooling system will switch over to chiller cooling mode.

Chiller Cooling Mode

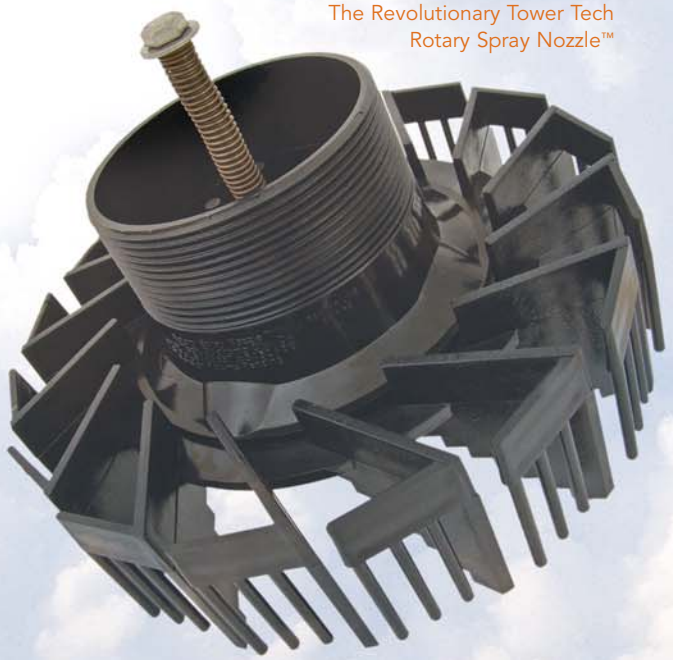
When the cooling mode is switched to Chiller Cooling Mode the cooling tower by-pass valve will be temporarily closed to the cooling tower. Both chiller isolation valves will be opened to full flow through the chiller condenser. The chiller condenser flow switch will prove flow and the lead chiller will be enabled. During chiller start up the condenser valve will be modulated to maintain a condenser leaving temperature of 70°F. As the condenser leaving water temperature rises above 70°F the cooling tower by-pass valve will be modulated to full flow to the tower. On a rise in tower leaving water temperature above 75°F, the tower fans will be enabled and the fan speed will be ramped to maintain leaving water temperature set point of 75°F. When the tower fans are at 100% speed and the tower leaving water temperature continues to rise above the set point the lag circulator will be enabled. The second pump will remain in operation until the fan speed begins to fall.

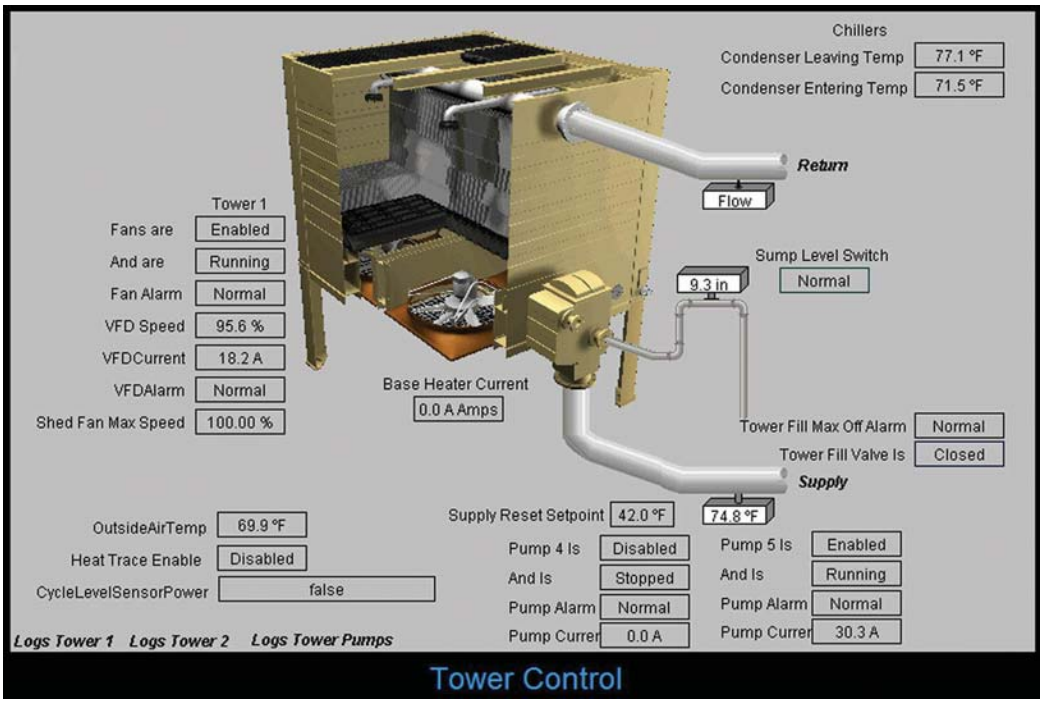
Results Overview

The installation of the Tower Tech cooling tower was completed without any major complications. With TBS's TAC web-based direct digital control system the cooling tower could be monitored during initial startup and through each change of seasons, especially when the outdoor temperature plummets.

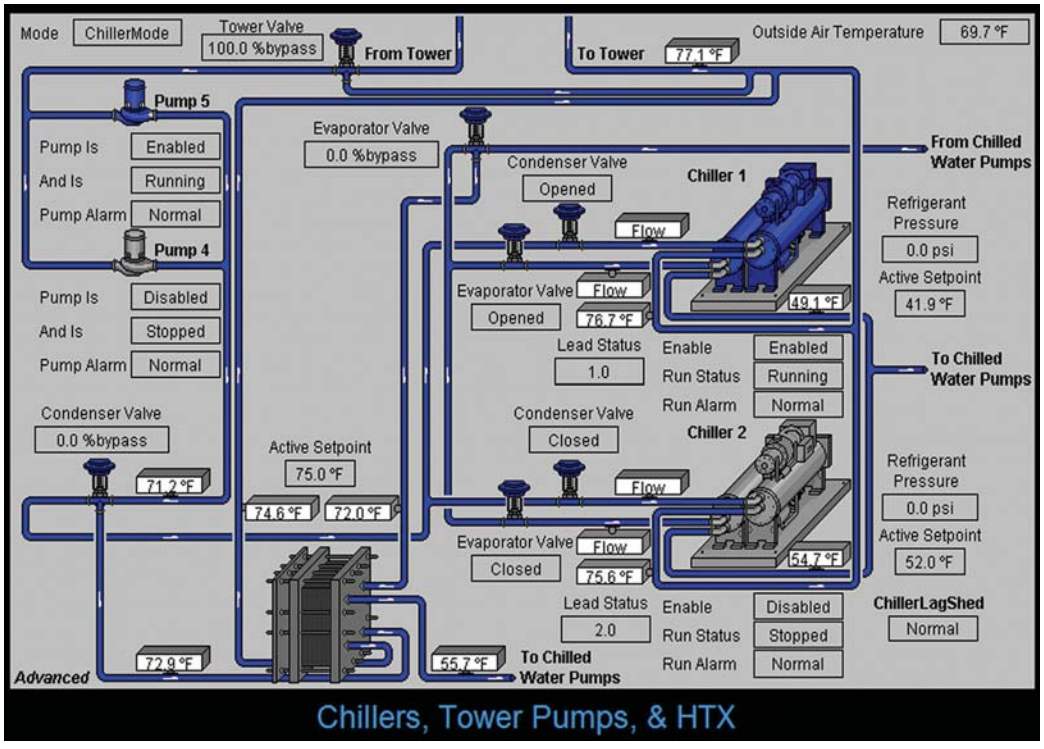
Energy savings were accomplished by controlling the tower fan and recirculating pump VFDs to take advantage of "free cooling" and by controlling the condenser water so the chillers run at part load, where they are most efficient. The Tower Tech cooling tower reduced total fan HP from 20 to 6. The new "free cooling" operational efficiencies have reduced the chiller run time by approximately 1,858 hours per year. The energy savings derive from a 33% reduction in electrical demand and from extended "free cooling" operation.

The Revolutionary Tower Tech Rotary Spray Nozzle™





TBS's dynamic graphic for the cooling tower shows the fans rotating, water level control, temperature monitoring, and make-up water control.



TBS's dynamic graphical user interface monitors multiple points in the chiller plant and includes capacity control, alarms, temperature monitoring, and freeze protection.

Hyde Collection Museum

The Hyde Collection, Glens Falls, New York, is a historic house and art museum complex that combines the heritage of the Adirondack Region in upstate New York with a distinguished permanent collection consisting of works by European old and modern masters and American artists, important decorative arts, and antique furnishings. In addition, the Museum provides changing exhibitions in four gallery spaces, lectures, concerts, family activities and school programming, as well as a Museum Store.

The Museum offers a world-class collection of objects that span the history of Western art from the fourth century BC through the twentieth century. The Museum's founders, Louis and Charlotte Hyde, acquired the majority of objects during a fifty-year period of avid and highly informed collecting. Many of these works are displayed in their home, known as Hyde House, as well as select galleries in the education wing. The permanent collection consists of approximately 3,000 paintings, sculpture, works on paper, furniture, and decorative arts. When the Hydes began collecting, their focus was not unlike that of their contemporaries. They acquired works by such artists as Botticelli, El Greco, Raphael, Rembrandt, and Rubens. In their most important decisions, notable scholars William R. Valentiner and R. Langton Douglas often guided them.

After the death of her husband in 1934, Mrs. Hyde continued to acquire new works. In fact, approximately two-thirds of the core collection reflects her personal decisions and taste. It was also during this time that she decided to broaden the scope of the collection with the help of her curator Joseph Jeffers Dodge. To that end, she purchased additional works by such modern masters as Cézanne, Degas, Picasso, Renoir, Seurat, and van Gogh. She also assembled a significant group of works by major American artists including Eakins, Hassam, Homer, Peto, and Ryder.

While the majority of the objects comprising the permanent collection were the result of the efforts of Louis and Charlotte Hyde, the collection continues to grow through acquisitions and bequests.

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Hyde Collection Museum

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www.TBSControls.com

August 22, 2007

Mr. Eugene Hickok
Advanced Comfort Systems
11 B Commerce Drive
Ballston Spa, NY 12020

Dear Gene,

In 2006 I was given the project to replace the controls for the chilled water plant at the Hyde Collection located in Glens Falls New York.

Our customer was replacing two Baltimore Aircoil closed circuit evaporative coolers with a new Tower Tech model TTXE-021930 open sump cooling tower. They were also eliminating the 40% propylene glycol and running water for the free cooling. Cooling tower water has tendency to freeze at the sub freezing temperatures we get in the northeast.

Also, we were going from one closed circuit cooler per chiller to a shared tower for both chillers. Our largest fear was the loss of control going to a single tower. After a meeting with the Tower Tech manufacturer's representative, Advanced Comfort Systems, and discussing the Tower Tech design, I was pleasantly surprised at the level of control. The 3:1 turndown spray nozzles and fan control actually gave us more temperature control then we had with the individual closed circuit coolers. Originally the free cooling mode was only effective at outside air temperatures below 28°F. Now with the Tower Tech units free cooling is possible up to 50°F eliminating chiller operation from over the 32°F range previously required resulting in huge energy savings.

After working out a few bugs, the tower ran flawlessly throughout the winter without freeze up.

Best regards,

James Price
Project Engineer
Technical Building Services, Inc.

THE HYDE COLLECTION

September 14, 2007

Mr. Eugene Hickok
Advanced Comfort Systems, Inc.
11 B Commerce Drive
Ballston Spa, NY 12020

Dear Mr. Hickok

Our Mission
As stated by Mrs. Hyde in her 1952 Trust Agreement establishing The Hyde Collection, our mission remains "to maintain a Museum for the exhibition of the permanent collection and to promote and cultivate the improvement of the fine arts, for the education and benefit of the residents of the Glens Falls vicinity and the general public."

That said, the Hyde Museum had a difficult decision to make with regard to replacing mechanical equipment that was beyond its useful life. I went to my long-term mechanical service provider, Technical Building Services for their advice. We discussed our selection criteria and the facility's priorities; they did their research and recommended a Tower Tech cooling tower.

The facility's priorities are:

1 – Maintain space conditions to protect the priceless art
2 – System redundancy
3 – Longevity in regard to outdoor environmental conditions
4 – Energy efficiency, in order to be a good steward of our contributor's dollars

All said and done, we went with Technical Building Services' recommendations. Tower Tech covered all of the facility's priorities. The redundancy was accomplished with one tower and, last but not least, saved us energy.

We reduced our electrical demand by 30% and we are now able to shutoff our chillers from October to April, when, in the past, we ran them year round.

We look forward to many years (decades) of service from our Tower Tech cooling tower.

Sincerely,

Keith Jablonski
Facilities Manager
The Hyde Collection

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