


# CHIEF ENGINEER™

APRIL 2026



**Boosting Water Efficiency and Conservation Milestones at Shedd Aquarium**

16



**Taking a Consultative Approach to Fluid Handling Applications**

28



**Discovering the Rooftop Tenants at 22 W. Washington St.**

34

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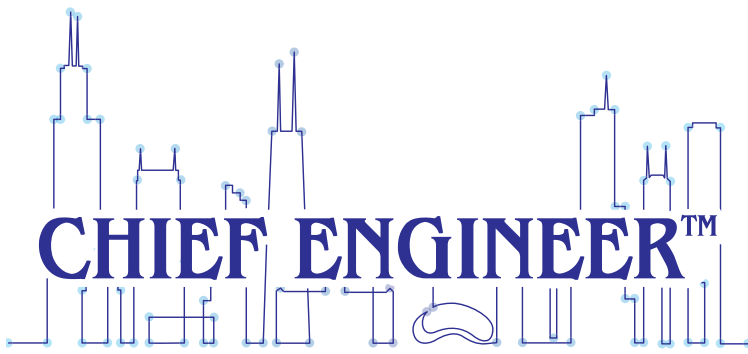
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# 16 Boosting Water Efficiency and Conservation Milestones at Shedd Aquarium

With new aquatic galleries on the horizon, the Shedd Aquarium found it was time to replace its pressure booster pump system. Metropolitan Industries proposed an ideal solution.

# 28 Discovering the Rooftop Tenants at 22 W. Washington St.

Chief Engineer Mike Lynch introduces us to the apiary that sits atop 22 W. Washington St., how the team integrates beekeeping into its routine, and why it's a boon to them and to the city.

# 32 Where Water Works — and Where It Doesn't: An Invitation to the Chief Engineers Community

In a discussion with Bornquist President David Everhart and Buildings Group Sales Manager, we learn what makes these manufacturer's representatives and fluid handling systems distinct in their field.

# 34 Taking a Consultative Approach to Fluid Handling Applications

HOH Water Technology invites the Chief Engineers to take part in a 6K as part of its initiative to provide clean water to areas of the world in need.

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**THE CHIEF ENGINEERS**  
ASSOCIATION OF CHICAGOLAND

# 2026 EVENT SCHEDULE



**APR 22**

WEDNESDAY 3:00PM

VENDOR FAIR

Back again by popular demand! Come see the industry's best at Morgan Arts Complex.

**MAY 20**

WEDNESDAY 3:00PM

BBQ

Spring is here and we're taking it outside for our annual BBQ event.

**JUNE 26**

FRIDAY

WHITE SOX GAME

Join CEAC members on the Fan Deck to cheer on the Chicago White Sox against the Kansas City Royals. Concert to follow. (Artist TBA.)

**SEPT 11**

FRIDAY 9:00AM

86TH ANNUAL GOLF OUTING

Everyone's favorite event takes over Cog Hill once again for the biggest event of the year! This event is on PAR!



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# PRESIDENT'S MESSAGE

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Dear Members,

We thought it might never arrive, but spring is actually here. It's been a challenging one, with colder-than-average temperatures, but by maintaining our PM schedules and maximizing our heating systems' efficiencies, we made it through and are looking forward to some more moderate temperatures ahead before the potentially extreme heat of summer arrives. It's a good time to get up on the roof and perform inspections and maintenance needed for your cooling towers, chillers and any other systems up there, including your roof itself.



It was great to see so many of you at our annual St. Patrick's Day Dinner at the Irish American Heritage Center. It's always one of the most popular Chiefs events of the year, it was great to see so many familiar faces and many new ones enjoying each other's company. We, of course, extend our sincere thanks to all of our sponsors, including Co-Sponsors Air Comfort and Chicago Backflow, our Bar Sponsors Abron Filter Supply, BEAR Construction, Chicago Filter Supply and Preservation Services, and to our Band Sponsor, ABM. Our thanks also go out to The Boils for providing their usual authentic Irish touch to the evening, to those on the Events Committee for their thoughtful planning, and to the staff at the Irish American Heritage Center for their professionalism and good cheer.

April's event, of course, is our now-annual Vendor Fair, at which all of our Associate Member organizations have the opportunity to show off their latest goods and services, and to interface with us on how they can best serve our needs as chief engineers and building managers. This event will take place Wednesday, April 22, from 4:00-7:00pm, at the Morgan Arts Complex (3622 S. Morgan St., Chicago). It's a great opportunity for our vendors, and we want to make sure that we're there for them the way they are for us. Registration for the Vendor Fair is open now, so please log on at [chiefengineer.org](http://chiefengineer.org) and confirm your attendance at this special event. As with all CEAC events, you get out of it what you put into it, so when you attend, be sure to make the rounds and learn what you can from our fine vendors.

Beyond April, we begin to wind the year down with our May BBQ event. Details to follow.

We encourage you to visit the Events page at [chiefengineer.org](http://chiefengineer.org) to learn more and to register.

I look forward to seeing all of you at the Vendor Fair!

Sincerely,

Larry McMahon



## ASHRAE and UNEP Approve Two-Year Work Plan Focused on Life Cycle Refrigerant Management

ASHRAE and the United Nations Environment Programme (UNEP) have approved a new two-year work plan titled Life Cycle Refrigerant Management (LCRM), reinforcing their long-standing partnership to advance sustainable refrigerant practices worldwide. The plan was adopted during the 2026 ASHRAE Winter Conference in Las Vegas.

As the refrigerating and air-conditioning (RAC) industry transitions to alternative refrigerants, comprehensive management across the full refrigerant life cycle, from production and installation to recovery, reuse and disposal, has become increasingly critical. Some legacy refrigerants can deplete the ozone layer if released, while certain alternatives introduced to replace them have high global warming potential (GWP). Effective life cycle refrigerant management helps reduce emissions, improve system efficiency and enhance safety for technicians and communities.

Since 2007, ASHRAE and UNEP have collaborated to support developing countries in transitioning to non-ozone-depleting refrigerants. Biennial work plans guide the development of joint technical resources and educational products to assist engineers, technicians, policymakers and National Ozone Units in meeting obligations under the Montreal Protocol while advancing energy efficiency goals.

The newly approved work plan includes:

- **RAC Technicians Field Companion** – An AI-powered, multilingual mobile application based on the Assessing RAC Plant Sustainability technical guide. The tool will provide real-time, context-aware guidance and automated documentation to support safe, practical implementation of life cycle refrigerant management practices.

- **Fact Sheets on Life Cycle Refrigerant Management and Energy-Efficient RAC** – A series of briefing documents covering topics such as the benefits of LCRM, conducting energy audits, safe use and handling of flammable refrigerants, and understanding regulatory requirements.
- **Updates to ASHRAE-UNEP OzonAction Joint Products** – Evaluation and enhancement of existing educational resources to incorporate life cycle refrigerant management guidance, including:
  - *Energy Efficiency Literacy online learning modules*
  - *Refrigerants Literacy online learning modules*
  - *University Course Pack for engineering instructors*
  - *Assessing RAC Plant Sustainability checklists and guidance sheets*
  - *Refrigerant Update Factsheet listing refrigerants with ASHRAE R designations, safety classifications and GWP*
  - *Lower GWP Award case studies highlighting replicable, cost-effective projects in developing countries*

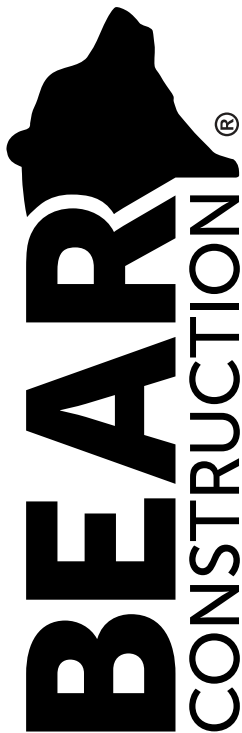
“Life cycle refrigerant management is essential to achieving global climate goals,” said 2025-26 ASHRAE President Bill McQuade, P.E., CDP, Fellow ASHRAE, LEED AP. “Even small refrigerant leaks reduce system efficiency and increase emissions. By emphasizing proper design, installation, maintenance and monitoring, LCRM improves safety, lowers energy use and reduces both direct and indirect emissions. It also strengthens local economies by supporting skilled jobs in refrigerant recovery, recycling and compliance.”

Jim Curlin, Head of UNEP’s OzonAction Branch, noted that the partnership bridges global environmental policy with technical standards and industry practice. “The collaboration provides specialized tools and services that help developing countries manage refrigerants responsibly, meet Montreal Protocol obligations and advance energy efficiency,” Curlin said. “ASHRAE contributes technical expertise in codes, standards and guidance for refrigerant use, while UNEP supports deployment aligned with global environmental goals.”

Jim Wolf, Presidential Member ASHRAE and co-chair of the ASHRAE-UNEP Liaison Group, emphasized the importance of safety during the refrigerant transition. “Some next-generation refrigerants are mildly flammable and require updated system design and handling practices,” Wolf said. “Life cycle refrigerant management helps ensure safe installation, operation, recovery and disposal under evolving standards.”

The work plan and access to joint ASHRAE-UNEP resources are available at [ashrae.org/ashrae-unep-portal](https://ashrae.org/ashrae-unep-portal).





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Formerly known as the Midwest Solar Expo, Intersolar & Energy Storage North America (IESNA) Midwest is the premier U.S.-based tradeshow and conference series dedicated to solar, energy storage, EV infrastructure, and manufacturing. IESNA Midwest offers three days of cutting-edge presentations, policy updates, networking opportunities, hands-on training, and exhibition showcasing the latest solar innovations. Designed for professionals across the clean energy industry, IESNA events offer:

- High-impact exhibit halls featuring the latest technologies and solutions
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IESNA Midwest offers professionals the opportunity to discover innovation, gain key information, build lasting relationships — and to have fun. Whether you're looking to advance your industry understanding, grow your business, or connect with peers, IESNA Midwest is a great place to be, offering hands-on training, state-level policy and market trend updates, and innovative exhibits right here in Chicago.

**Highlight: The Solar Games**

The Solar Games is the industry's first installer competition, tasking teams with building residential solar + storage systems live in the Intersolar & Energy Storage North America expo hall.

The competition takes place over the course of three days:

- Six teams take part in Round 1 on day one.
- The top four scoring teams in Round 1 advance to the Semi-Finals on day two.
- The top two scoring teams in the Semi-Finals advance to the Championship Round on day three.

Competing teams are judged on installation quality, safety, speed, and more as they advance through the tournament. The winning team takes home a \$10,000 cash prize — and the title of Solar Games Champion.

**Prizes**

- **First Place:** \$10,000
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- **Third Place:** \$2,500

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### Are You Prepared for DOE Changes?

As part of a nationwide effort to reduce energy consumption, the Department of Energy (DOE) is implementing new efficiency standards for commercial water heaters effective October 6, 2026. HSA is here to help you understand the impact, navigate product changes, and stay compliant with confidence.



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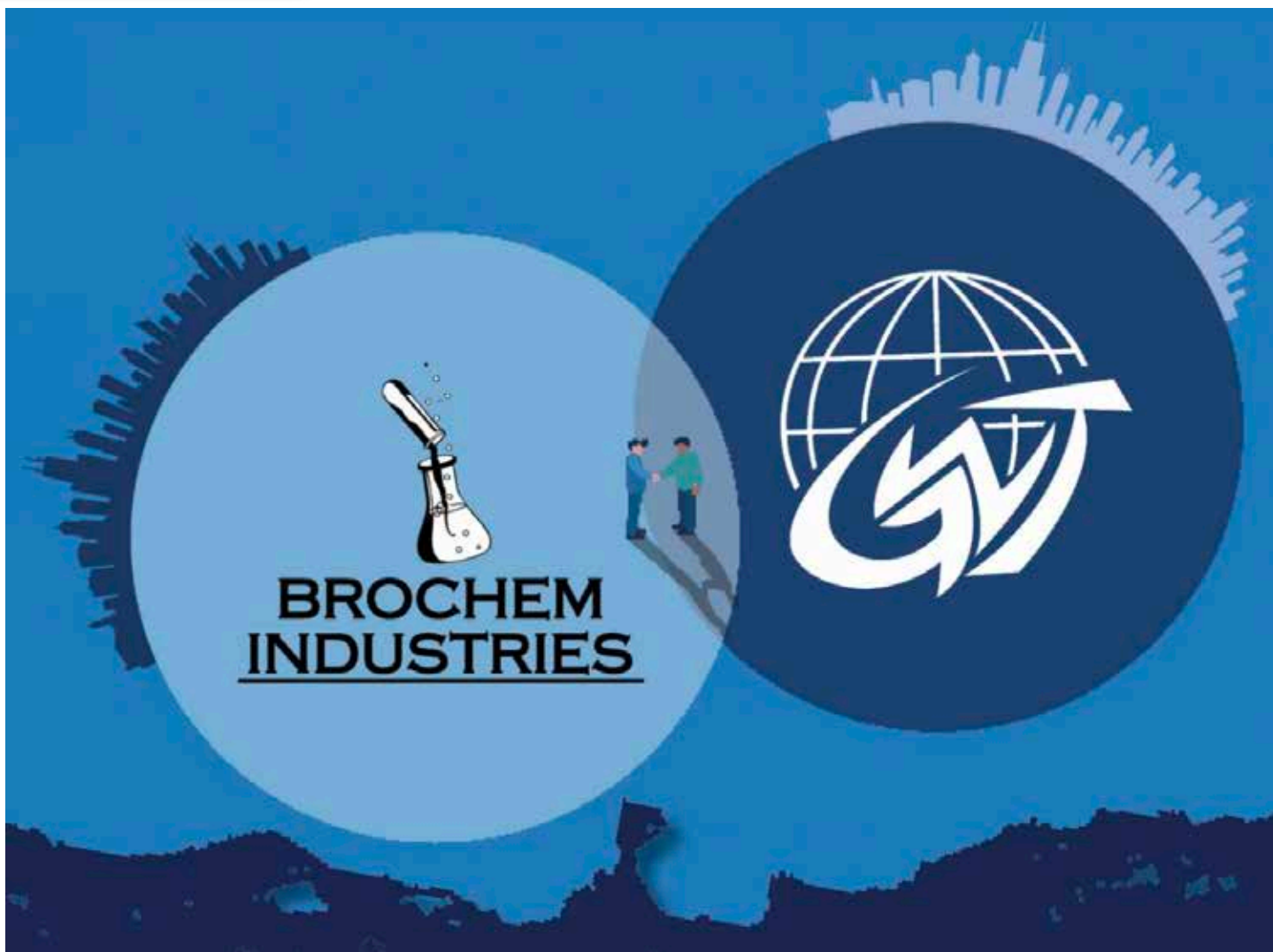
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*Global Water Technology, Inc. (GWT), recently acquired Brochem Industries, a specialized private-label blender and manufacturer of water treatment chemicals serving independent and regional water treatment providers nationwide.*

## Global Water Technology Acquires Brochem Industries, Expanding National Global Custom Solutions Platform

Global Water Technology, Inc. (GWT), recently announced its acquisition of Brochem Industries, a specialized private-label blender and manufacturer of water treatment chemicals serving independent and regional water treatment providers nationwide.

Founded in the early 2000s, Brochem has earned a reputation as a trusted partner to independent and regional water treatment firms that value responsiveness, flexibility, and dependable blending and manufacturing support without maintaining in-house production infrastructure.

The acquisition of Brochem meaningfully expands GWT's Global Custom Solutions (GCS) platform, a business segment


designed to enable trusted independent and regional water treatment partners to leverage the full scope and scale of GWT's services and capabilities, including custom blending, private-label manufacturing, technical expertise, regulatory support and operational infrastructure. In an industry increasingly shaped by consolidation, the GCS platform is intended to empower independent partners with the scale, flexibility, and resources needed to compete and grow without sacrificing operational independence, while creating durability and security through partnership with a trusted organization that shares their commitment to independence, entrepreneurship and long-term creative collaboration over competitive confrontation.

By leveraging the breadth of GWT's capabilities, the GCS platform helps partners to address gaps as they arise, including through leveraged commodity chemical sourcing and supply, purchasing power advantages, coordinated multi-site portfolio service coverage beyond partners' traditional regional operating zones, water safety services, wastewater treatment products and technical support, pure water solutions, and other value-added resources. The platform

further contributes to long-term organizational resilience by giving partners access to GWT's institutional infrastructure and support network, helping strengthen continuity and stability during periods of change.

Through integration with GWT, Brochem's clients will benefit from expanded technical and operational capabilities supported by GWT's continued investment in its modern Calumet City manufacturing facility, resulting in enhanced production quality, greater consistency, and increased capacity to support partner growth.

Brochem's partner-focused business model complements GWT's existing service and product offerings by strengthening supplier, blending, and manufacturing capabilities. Together, the organizations will deliver greater formulation flexibility, increased production capacity, enhanced responsiveness, and expanded private-label solutions to independent and regional partners nationwide.

The transaction aligns with GWT's long-term strategy of growing both organically and through targeted acquisitions that deepen core competencies, strengthen partnerships, and create scalable platforms that support the broader water treatment industry. 

For more information, please contact GWT at [info@gwt-inc.com](mailto:info@gwt-inc.com) or (708) 349-9991.

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## Maintenance Performance of Cooling Towers

Cooling tower maintenance is, by necessity, an ongoing endeavor. Not only is proper preventive upkeep key to maintaining efficiency and system performance, but lapses in routine maintenance can lead to potentially serious health issues, and in extreme cases, loss of life. As we enter the warmer months of the year and ready our cooling towers for what's ahead, let's take a look at some of the things to look for that can inhibit cooling tower performance, and what we can do to ensure that our towers are working at peak performance.

### What might be affecting your cooling tower's performance?

- **Scale Deposits** – When water evaporates from the cooling tower, it leaves scale deposits on the surface of the fill from the minerals that were dissolved in the water. Scale build-up acts as a barrier to heat transfer from the water to the air. Excessive scale build-up is a sign of water treatment problems.
- **Clogged Spray Nozzles** – Algae and sediment that collect in the water basin as well as excessive solids that get into the cooling water can clog the spray nozzles. This causes uneven water distribution over the fill, resulting in uneven airflow through the fill and reduced heat transfer surface area. This problem is a sign of water treatment problems and clogged strainers.
- **Poor AirFlow** – Poor airflow through the tower reduces the amount of heat transfer from the water to the air. Poor airflow can be caused by debris at the inlets or outlets of the tower or in the fill. Other causes of poor airflow are loose fan and motor mountings, poor motor and fan alignment, poor gear box maintenance, improper fan pitch, damage to fan blades, or excessive vibration. Reduced airflow due to poor fan performance can ultimately lead to motor or fan failure.
- **Poor Pump Performance** – An indirect cooling tower uses a cooling tower pump. Proper water flow is important to achieve optimum heat transfer. Loose connections, failing bearings, cavitation, clogged strainers, excessive vibration, and non-design operating conditions result in reduced water flow, reduced efficiency, and premature equipment failure.


An improperly maintained cooling tower will produce warmer cooling water, resulting in higher condenser temperatures than a properly maintained cooling tower.

This reduces the efficiency of the chiller, wastes energy, and increases cost. The chiller will consume 2.5 percent to 3.5 percent more energy for each degree increase in the condenser temperature.

For example, if a 100-ton chiller costs \$20,000 in energy to operate each year, it will cost you an additional \$500 to \$700 per year for every degree increase in condenser temperature. Thus, for a 5°F to 10°F increase, you can expect to pay \$2,500 to \$7,000 a year in additional electricity costs. In addition, a poorly maintained cooling tower will have a shorter operating life, is more likely to need costly repairs, and is less reliable.

### Employing diagnostic tools to evaluate your cooling tower's performance

In addition to the preventive maintenance checklist provided here, you might need to employ some advanced diagnostic tools to get the clear and fullest picture of what is happening inside your cooling tower.

- **Thermography** – An infrared thermometer or camera allows for an accurate, non-contact assessment of temperature. Applications for cooling towers include bearing and electrical contact assessments on motor and fan systems as well as hot spots on belt and other drive systems.
- **Ultrasonic analyzer** – Electric motor and fan systems emit very distinct sound patterns around bearings and drives (direct or belt). In most cases, these sounds are not audible to the unaided ear, or are drowned out by other equipment noises. Using an ultrasonic detector, the analyst is able to isolate the frequency of sound being emitted by the bearing or drive. Changes in these ultrasonic wave emissions are indicative of changes in equipment condition – some of which can be a precursor to component degradation and failure. 

Source: U.S. Dept. of Energy

**J&L Cooling Towers, Inc.**

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## Cooling Tower PM Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Cooling tower use/sequencing	Turn off/sequence unnecessary cooling towers	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Inspect for clogging	Make sure water is flowing in tower	X			
Fan motor condition	Check the condition of the fan motor through temperature or vibration analysis and compare to baseline values		X		
Clean suction screen	Physically clean screen of all debris		X		
Test water samples	Test for proper concentrations of dissolved solids, and chemistry. Adjust blowdown and chemicals as necessary.		X		
Operate make-up water	Operate switch manually to ensure proper float switch operation		X		
Vibration	Check for excessive vibration in motors, fans, and pumps		X		
Check tower structure	Check for loose fill, connections, leaks, etc.		X		
Check belts and pulleys	Adjust all belts and pulleys		X		
Check lubrication	Assure that all bearings are lubricated per the manufacture's recommendation			X	
Check motor supports and fan blades	Check for excessive wear and secure fastening			X	
Motor alignment	Aligning the motor coupling allows for efficient torque transfer			X	
Check drift eliminators, louvers, and fill	Look for proper positioning and scale build up			X	
Clean tower	Remove all dust, scale, and algae from tower basin, fill, and spray nozzles				X
Check bearings	Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary.				X
Motor condition	Checking the condition of the motor through temperature or vibration analysis assures long life				X

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# Boosting Water Efficiency and Conservation Milestones at Shedd Aquarium



Chicago's Shedd Aquarium on Lake Michigan — a National Historic Landmark and a point of pride for our great city. (Photo: Shedd Aquarium)

A renowned destination and architectural marvel along the shores of Chicago's Lake Michigan, Shedd Aquarium is recognized as a National Historic Landmark, welcoming 2 million guests annually to explore vibrant, immersive exhibits that showcase thousands of aquatic animals and environments.

Beneath each freshwater and saltwater habitat lies a complex, carefully managed operations system that sustains aquatic life and maintains the infrastructure supporting the daily needs of staff and visitors alike. As the historic aquarium approaches its centennial anniversary in 2030, the organization is currently undertaking a substantial, multi-phase physical transformation that will bring new animal exhibits, an expansion of programs, and infrastructure upgrades upon completion in 2027. This experience evolution is part of a larger strategic plan — Shedd's Centennial Commitment — that is preparing the aquarium for the next 100 years of service.

A pivotal benchmark in the transformation timeline is the anticipated change in the building's water usage profile with the coming additions of the River Wonders and the Living Lakes aquatic galleries. The additional demand to maintain the upkeep and periodic maintenance of these new habitats — without affecting the pressure balance that transports domestic

water to the rest of the building — brought into question the realistic longevity of the existing pressure booster pump system, which had been in service since 1988.

"We definitely got our investment's worth, probably about five times over," said Bob Wengel, Sr. Vice President of Facilities and Security at Shedd Aquarium. "After nearly 40 years, the booster system was nearing its maximum capacity at its current usage. Given its age and the extra capacity we need as new habitats come on, it got us thinking about a replacement."

Preparation got underway in 2023, when Shedd tasked their mechanical-plumbing-engineering team to consider possible designs for a new system. The forward-leaning vision is a testament to how the iconic institution has continued to uphold its standard of operational excellence throughout its first century.

Metropolitan Industries was brought on board as the preferred supplier to design and assemble a custom-engineered booster pump package. According to Wengel, Shedd's relationship with Metropolitan is a continued collaboration stemming from the success of previous projects — such as the dual pump system that powers the "Man with Fish" fountain statue outside the building's main entrance.



Approximately 2 million guests visit the Shedd Aquarium every year to explore the awe and majesty of underwater life. (Photo: Shedd Aquarium)

## Advancing Water Conservation Success

A crowning achievement Shedd Aquarium proudly celebrates is the success of its ongoing water conservation efforts. “Between 2012 and 2018, we reduced our water consumption by 50 percent,” Wengel said.

The conservation effort began with multiple water audits, and a thorough examination of the building’s mechanical and raw plumbing uses. Wengel attributed the significant water savings to behavior changes on top of many simple and advanced efforts — from switching fixtures to lower-flow faucets, and removing automatic flush valves from toilets to designing a new cooling tower that streamlines heat rejection and energy usage by centralizing refrigeration loops into a single condenser.

“We use a considerable amount of water to support our aquatic animals,” Wengel said. “Over that six-year period, we got to a 50-percent reduction in use. The takeaway is, if we can achieve that, so can others.”

In the years since the previous booster was put into service, advancements in energy-efficient pumping and control technologies paved the way for a state-of-the-art solution capable of meeting future water demands and further supporting the institution’s conservation efforts.

## A Data-Driven Approach to Equipment Selection

Among Shedd Aquarium’s priorities was implementing real-time monitoring of water flow throughout the building. “Seeing our usage in real time gives us a way to question irregularities and identify sudden increases in gallons per minute or energy usage,” Wengel said. “The monitoring data will help us pinpoint any leaks or energy losses which may compromise the efficiency of our conservation plan.”

“Shedd gave us an overview of the different processes that go on in their building,” said Matt Brickey, commercial sales representative at Metropolitan Industries. “We conducted a detailed flow-study to collect the building’s trending data over a two-week period. We used that information and took into account additional process information to make an informed, data-driven equipment selection.”

The outgoing triplex booster system gave way to a variable-speed, multi-stage quadruplex system. The Metropolitan-engineered package features a downstream flow meter for precise water usage measurement, the MetroTech III Pro controller for seamless monitoring and integration into the building automation platform, and variable frequency drives



Every freshwater and saltwater habitat at the Shedd relies on a complex, carefully managed operations system to sustain the aquatic life it contains. (Photo: Shedd Aquarium)

that automatically adjust pump speeds to maintain setpoint pressures — improving energy efficiency and reducing mechanical wear.

To ensure balanced pressure throughout the building, the booster system incorporates multiple hydropneumatic tanks that manage varying flows and pressures, minimizing large demand fluctuations. This design enables rapid flow adjustments instead of the typical rise-and-fall cycles from conventional systems. The increased efficiency also allows the booster to shut down automatically when no flow is required, improving system efficiency.

A central theme in Shedd’s enterprise risk management strategy is redundancy. The upgrade from a three-pump to a four-pump system enhances backup capacity in case one of the other pumps becomes inoperable, significantly reducing the risk of system downtime. The four pumps are connected to two separate electrical feeds, allowing the building to continue providing water even if one power source fails.

“Shedd is very unique from the standpoint of their water usage,” Brickey said. “Not only do they have regular day-to-day sink and toilet uses, but they also have high-volume processes and fillings necessary to maintaining vital habitats.”

“This is why what we do is so fulfilling,” Brickey added. “Metropolitan understands not every application is the

same. Anyone can easily replace an outgoing system with a cookie-cutter system with similar capabilities. We gain a true understanding of how each building operates. And we also gain a true understanding of stakeholder objectives and what they want in a new system, then we put it all together and build it.”

### **Seamless Transition in Action**

The new booster pump system was engineered and assembled by Metropolitan in a factory-controlled environment at its Romeoville, Ill., facility, and the packaged, skid-mounted unit was delivered to Shedd Aquarium ahead of its scheduled July 2025 installation.

A critical priority in the replacement plan was to avoid a prolonged interruption of the building’s domestic water service. The transition required careful planning and additional temporary measures to ensure that the water supply remained available throughout the process. Although the aquarium’s animal life is supported by specialized, independent life support systems designed for continuous, redundant operation, an extended water outage would have disrupted many essential daily operations — like cleaning habitats, sanitizing equipment, and maintaining visitor services — highlighting why minimizing disruption was mission-critical.

“A temporary booster pump and controller supplied by Metropolitan allowed Shedd to maintain normal operations



Redundancy is key to the Shedd's risk management strategy. Upgrading to a four-pump, skid-mounted system from a three-pump arrangement augments backup capacity in case one of the other pumps fails, reducing the risk of system downtime. (Photo: Shedd Aquarium)

during the week-long transition phase," Brickey said. "The temporary booster went in and kept the building's water going once the old system went offline. Shedd operated on the temporary booster while the old system was decoupled and removed to make way for the new system."

A planned shutdown of the building's water accompanied the temporary booster's installation — scheduled and executed in the overnight hours to minimize disruption. Brickey was on site during the installation along with a personnel member from Metropolitan's service department to provide immediate support to the installing contractor if needed. "The temporary booster went in exactly as planned, and the shutdown was limited to only a few hours."

The supplied pump and motor drive that made up the temporary system were strategically selected to match that of the incoming system. "With only minimal modifications, we were able to do everything we needed from an operational standpoint until the replacement system was brought on," Wengel said. "No one else in the building would have noticed anything unusual as the old system was being decoupled."

The new system was commissioned and brought into service one week after the initial shutdown of the old system. Wengel and Brickey credit Ewing Doherty Mechanical, the contracting

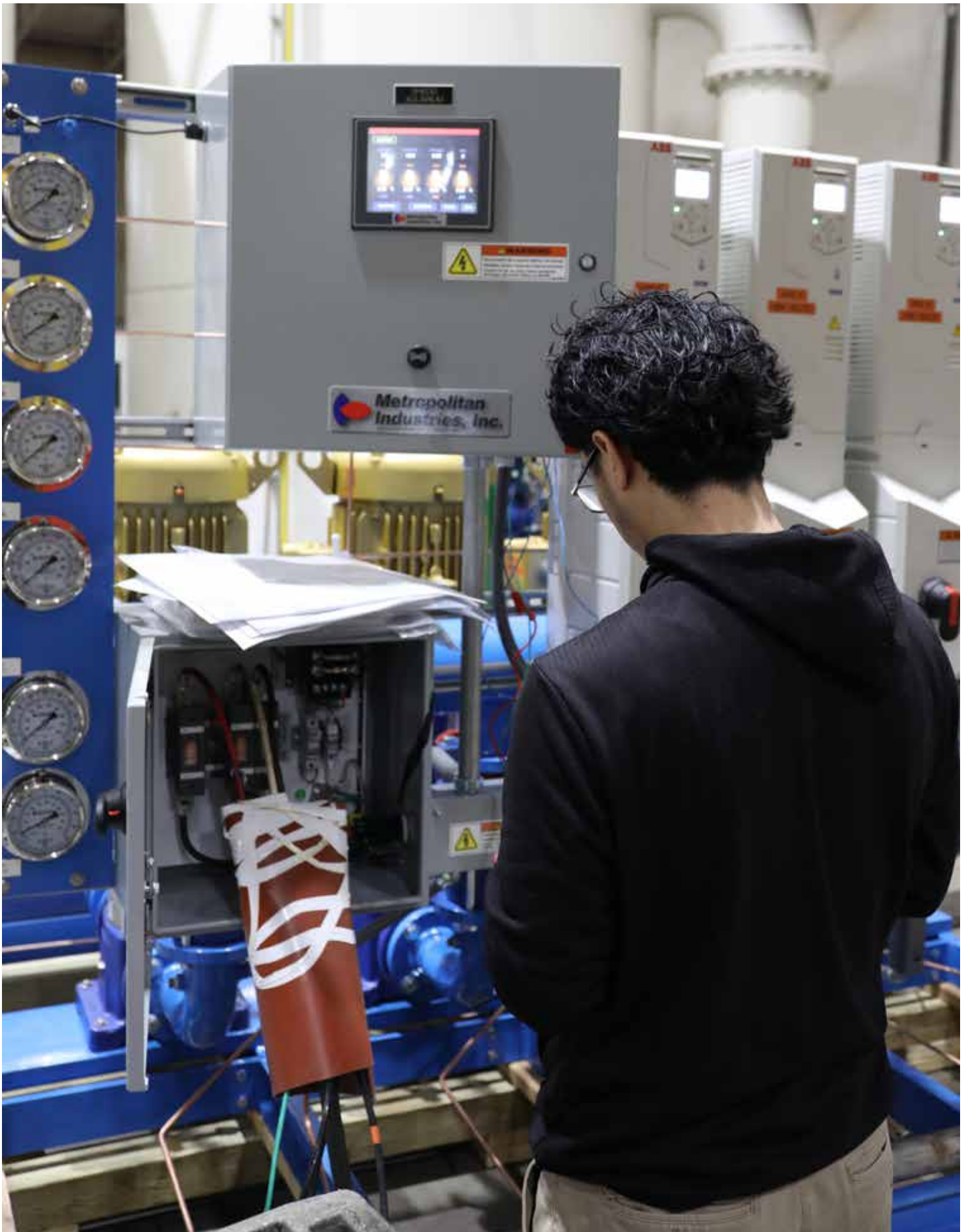
firm based in Bensenville, Ill., for executing a carefully planned transition that kept building operations uninterrupted. "The switchover was seamless," Wengel said. "After the Ewing Doherty team took out the old system and got the new system and piping in place, they completed the cutover in one night."

To ensure smooth onboarding for the building's operational staff, Brickey held on-site training sessions, including comprehensive walkthroughs of the new controls, programming setup, and each setpoint. Wengel added that "Matt was very thorough during the startup and training sessions, making sure everything went along smoothly."

### Preserving While Expanding

Wengel looks forward to analyzing the long-term totalized values as the new booster pump system continues to provide real-time trending data over the coming months and years.

The successful upgrade is one of several recent examples of how operational integrity and conservation move in tandem at Shedd Aquarium — what Wengel calls "preserving as we're expanding." Wengel hopes these efforts may be judged favorably by whomever is occupying his chair 30 years from now — just as he remains in constant awe of those who came before him.



Redundancy extends to the pumps' power sources, with the four pumps being connected to two distinct electrical feeds, ensuring that they can provide water even if one of the power sources fails. (Photo: Shedd Aquarium)



Metropolitan Industries' four-pump system fully integrated and operational at the Shedd Aquarium. (Photo: Shedd Aquarium)



Large, easy-to-read pressure gauges take any guesswork out of monitoring of each of the four pumps in the system. (Photo: Shedd Aquarium)

As the building transformation nears completion and the centennial celebration approaches, Shedd Aquarium stands poised to continue its stewardship of aquatic animal life, champion environmental responsibility, and inspire new generations — well into the next hundred years. 🏢 🏢

For additional information about Shedd Aquarium's Centennial Commitment, visit [www.sheddaquarium.org/about-shedd/centennial-commitment](http://www.sheddaquarium.org/about-shedd/centennial-commitment).

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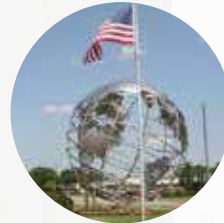
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The annual Skatefest event is always a great time, and Skatefest 2026 was no exception, thanks to everyone who planned and participated to make it so. Our thanks go out to everyone involved, from our Events Committee for setting it up, and to the folks at the Morgan Park Sports Center for their cooperation and assistance. Endless gratitude to our event sponsors, Air Comfort and HOH Water Technology, for their support. As always, if you need outside assistance with your building systems, we ask you to reach out to them and to all of our Associate Member organizations who are so supportive of the CEAC.



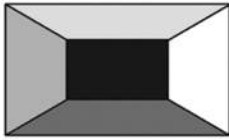
For now, we're looking forward to the Vendor Fair later this month, where our Associate Member organizations put their best foot forward, presenting their latest wares and services. The Vendor Fair will be held Wednesday, April 22, from 4:00-7:00pm, at the Morgan Arts Complex (3622 S. Morgan St., Chicago). Registration is now open at the Events page at [chiefengineer.org](http://chiefengineer.org).



Associate Organizations wishing to sponsor future CEAC events are encouraged to reach out to us at [events@chiefengineer.org](mailto:events@chiefengineer.org).







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# Taking a Consultative Approach to Fluid Handling Applications

By Karl J. Paloucek

*Arboretum Lakes Chief Engineer Keith Wilburn, Bornquist's Nate Hultgren and Anchor Mechanical's Dan Pufunt examine a Bell & Gossett e-1510 pump, Bell & Gossett Triple Duty Valve and Metraflex flex connectors.*

Things are happening at Bornquist. The company was first established in downtown Chicago in 1937 — a group of Bell & Gossett representatives peddling residential pumps out of the backs of their station wagons. In the near century since, it has grown into a company with a sterling reputation as system experts in the HVAC and plumbing industries, specializing in a full array of fluid handling application products. Since the mid-1960s, Bornquist has been working out of its 34,000-sq-ft facility in the Wildwood neighborhood of Chicago, offering sales, service, in-house fabrication, education and efficient solutions to the markets it serves. Now, the company is on the verge of moving to a 60,000-sq-ft building in Northbrook to accommodate its continued expansion.

“We represent about 25 manufacturers within the HVAC and plumbing market,” President David Everhart says, adding that in addition to their Chicago office, they maintain a facility in East Moline. “They cover the western part of the state, down to maybe the central part of the state. Our overall area is the Greater Chicagoland Area, which includes a few counties in Iowa, a few counties along the bottom of the lake in Indiana, and goes down roughly to Springfield. We have approximately 80 employees, now.”

For all of the growth and expansion over the decades, the focus at Bornquist remains the same — hydronic HVAC and plumbing systems. Though Everhart says that they do feature some refrigerant-based lines these days, and they represent roughly two dozen other manufacturers, it's their relationship with Bell & Gossett that remains the core of their business. “The Bell & Gossett pump line and its accessories are the major part of what we do,” he explains. “Bell & Gossett manufactures pumps and accessories that start at the residential level and then go up to the very largest commercial-style pumps. Large commercial-style pumps and accessories are the ones that are predominantly used in data centers, and the cooling is done with water, so we are exposed to that business.”

The proliferation of data centers nationwide is having a massive impact on nearly every facet of construction, and Bornquist is as active as any player in the industry as a result. “We're certainly evolving,” Nate Hultgren, Building Group Sales Manager, offers. “There are large projects out there right now, and it's certainly been driving our business — just because the amount of dollars involved in those projects is just gigantic.”



Building Group Sales Manager Nate Hultgren and President David Everhart visit the new office in Northbrook, Ill., preparing for this year's Vendor Fair.

Everhart agrees. "Bell & Gossett is a big brand for us in the data center market," he says. "Metraflex, another Chicago-based manufacturing company, is a big name in the data center market, and then Wessels, which is one of the tank lines that we represent — Cemline is another one. Those guys manufacture thermal storage tanks, for example, and a lot of these data centers are putting in huge thermal-storage-based facilities for their coolant."

Data centers currently are pivotal to construction right now, as tech companies move to rapidly expand the footprint of A.I. in our world. But what about A.I. in the hydronic HVAC and plumbing markets? What is that looking like, both in the here and now, and on the horizon? According to Hultgren, Bornquist is keeping apace with A.I.'s incursion into the products and services they offer.

"We have the detection group line, which is part of Nexa, which is a Watts product," he says. "They're trying to look now where they can gather data on the complete system with the flow rates and temperatures, and understand through A.I. how the building is using energy, and how to maximize the efficiency. So that is a trend we're starting to see, and B&G is working with some companies as well, to see if they can leverage that as well. We are starting to see, using A.I., to try to improve the efficiency of existing buildings, so I would definitely say that's coming, and I think that's going to be a big focus in the next few years."

### The Bornquist Difference

A.I. may be a new information revolution in the making, but for the team at Bornquist, they continue to take a classic "consultative" approach to their business relationships, because they're keenly aware of what their role is with regard to their

potential clients, and they have developed their own way of ensuring that they're offering their best service to each of them. Together, Bornquist employees have more than 500 years of experience in the Industry.

"Having a focus on different customer markets," Hultgren says, with frankness. "The Chief Engineers are very different from the contractors, or the consulting engineers. So the way that you approach and the way that you want to go to market is different, as well. We just try to be aware of that, and try to approach that the best way we can."

"Most sales organizations divide up geographically, and then they have sales people who call on all of the customers in that geographic area," Everhart explains. "But we've found, historically, that your brain eventually runs out of room. It's hard to be an expert in all of those different areas, particularly with all of the product changes. So our idea at the time was to go in with expertise. We created these divisions — we have our Plumbing Division. We have an HVAC Division. We have a Buildings Group. And all of those people have different salespeople to call on the appropriate customer class. So on the building side of things, which Nate heads up, he has a sales team that they're going in to call on the owners — again, on the consultative sales model — to find out what it is that their pain point is, and if we have a way to address it."

"Our [Buildings] Group is client-focused specifically on the building engineers," Hultgren says. "That's our focus, as well as some service contractors."

"We try to do it in a way that doesn't compete with our customers," Everhart clarifies. "That's the part that some people kind of have

trouble understanding, is we're not really here to compete with our stocking distributors, or our service contractors — that's the consultative approach that we take, because the most important thing we're providing is information. When the customer does decide to do something, they come in as smart as possible on that project."

### Adapting to the Needs of the Market

Specialized expertise is a major part of the Bornquist equation, but so is reliability, and being there when clients are in acute need. When COVID began to put the squeeze on supply chains for so many industries, and wait times for new pumps started creating real headaches for the contractors and building engineers who needed them posthaste, the team at Bornquist took up action stations and responded to the need by assembling their own pumps — a practice that they continue to maintain.

"We buy pump kits from the manufacturer, and then we can basically trim the impeller, put the motor on and ship that pump out within about two weeks, typically," Hultgren says. "That's not for every model, but for the core models that we see in the field."

"Right. And we would provide startup for that," Everhart adds. "That's one of the reasons for the move to the new building — we've just become so full of inventory that we need more warehouse space."

While Bornquist's service department commits to the task of assembling pumps as needed, they're still available to work on their clients' pumps as needed. If your pump needs a new seal, or a coupler needs changing, they have your back. Bornquist takes a lot of pride in its Service Department's reputation, at times taking care of issues at no charge.

This is a recurring theme with Bornquist — providing complementary service to its clients to keep their operations running as smoothly as possible. "One of the services that we provide to building owners is a mechanical room audit, where we will identify all the pumps, drives, whatever they want us to identify that they have in their building," Everhart says. "And we'll put a spare parts book together for them, if it's product that we represent."

"For all of the Bell & Gossett pumps, we've been doing that quite a bit," Hultgren adds. "It could be 120 pages. We'll have pictures of the nameplate, a picture of the pump, a complete parts list so that they can reference and, say, if something goes wrong with chilled water pump one, I can just pull out my book and say, 'Here's the parts list — here's what I need.' And that's just a resource. It makes it so much easier for them. Or they can call us, and we have [the reference book], too."

"And it's free of charge," Everhart says.

### Bornquist at CEAC Vendor Fair 2026

Naturally, Bornquist plans to attend the Chief Engineers Association of Chicagoland's annual Vendor Fair. And they're enthusiastic about what they plan to present to the Chief Engineers in attendance.

"We have the [Xylem] hydrovar® X, which is the new motor-and-drive combo, where the drive is built into the motor — the



Keith Willburn and Nate Hultgren check out a set of Danfoss VFDs.

IE5," Hultgren says. "We'll be showcasing that. That's the newest technology, because we're starting to see that pop up now, and become a little bit more popular. The energy efficiency of the motor is the highest on the market right now."

"IE5 is an electrically commutated motor — it's a totally different construction than having a rotor and a stator, and windings, and all of these other things," Everhart says. "These motors are operating more smoothly than the old-technology Premium Efficient motors are. They have different speed ranges. And the hydrovar X is cool because it's an IE5 motor that has ferrous, all-sustainable construction. We don't have rare-earth magnets in that motor."

Leak detection is also on the Vendor Fair agenda for Bornquist, as they plan to spotlight The Detection Group/Nexa brand and everything that goes into that particular system. "The smart-based station, the hubs, the sensors, the ropes to extend the sensor reach — we'll be talking about that," Hultgren says. "We'll be highlighting our AERCO boilers and our PVI water heaters. And there are some things that they're coming out with — I hope they're out by April, because I'd like to showcase them, but I don't want to say until they're actually official. AERCO has an electric boiler that they recently came out with as well, so we'll have information on that."

Look forward to meeting David Everhart and Nate Hultgren and hearing about everything Bornquist has to offer at the Vendor Fair on Wednesday, April 22, at the Morgan Arts Complex in Chicago. 📍



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## Where Water Works — and Where It Doesn't: An Invitation to the Chief Engineers Community

HOH Water Technology invites you to take part in the World Vision Global 6K for Water on Saturday, May 16.



HOH Water Technology has set a goal of 500 participants for this year's 6K.

As Chief Engineers, you understand something most people never have to think about: Water systems must be protected, monitored and managed. When cooling towers, boilers, closed loops and domestic systems function properly no one notices. When they don't, everything stops.

In many parts of the world, those systems don't exist at all.

HOH Water Technology exists to make a lasting impact — on its customers, on its coworkers, and on its community. Since 2017, that purpose has extended beyond the mechanical rooms and facilities it serves and into communities around the world through a partnership with World Vision.

One of the most tangible ways HOH lives that commitment is through the World Vision Global 6K for Water, taking place this year on Saturday, May 16.

### Why 6K

Six kilometers, or 3.7 miles, is the average distance many people, often women and children, walk every single day to collect water. Not clean water — not treated water — just water.

During a visit to Honduras, our team met a young girl who wakes up at 5 each morning before school to walk steep terrain to collect water for her family. At 8 years old, her day begins with a responsibility many of us cannot imagine — carrying heavy containers back home before starting school.

For us, turning on a faucet is automatic. For millions, water is a daily physical and health risk.

As engineers and facility leaders, you understand the importance of safe, reliable water systems. You know what happens when water isn't properly managed. Scale, corrosion,



Participants can walk or run as part of the HOH team, or can do the 6K wherever they would like.

bacteria and system failure are just some of the issues. Now imagine when there is no system at all.

Water changes everything. The impact is simple and powerful:

- \$50 provides one person with clean water for life.
- HOH has set a goal of 500 participants this year.
- That means together, we can bring clean water to 500 people.

Clean water improves health. It reduces waterborne illness. It allows children to attend school consistently. It restores dignity. It creates economic opportunities. It stabilizes communities.

For those of us responsible for protecting critical building systems, this is a cause that connects directly to what we do every day, ensuring that water works.

### **A Team-Building Opportunity for the Engineering Community**

The Global 6K is not a race. You can walk or run anywhere! At your building, in your neighborhood, with your team or individually. It's an opportunity to bring together:

- Engineering teams
- Building staff
- Vendors and partners
- Family and friends

Imagine your facility team walking together on May 16, knowing your steps represent the distance someone else no longer has to walk.

This is more than participation. It's leadership. It's alignment. It's impact.

### **Join Us**

HOH Water Technology invites the Chief Engineers Association of Chicagoland community to join us in making a lasting impact.

### **World Vision Global 6K for Water Team Walk**

**Date:** Saturday, May 16 at 9:00am

**Meeting Place:** Springfield Park,  
269 Springfield Dr., Bloomingdale, Ill. \*

**\$50 = Clean water for one person for life**

Join the HOH Water Technology team  
or make a donation at:  
[global6k.worldvision.org/teams/39565](http://global6k.worldvision.org/teams/39565)

\*Team participation onsite not required — you can do your own 6K wherever you would like!

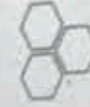
For more information or to coordinate participation, please contact Tammy Faber, sales director for HOH Water Technology, at [tfaber@hohwatertechnology.com](mailto:tfaber@hohwatertechnology.com).

The people at HOH Water Technology believe that where water works, life works. And when all of us come together as an industry that understands water better than most, it's a unique opportunity to extend our impact beyond our buildings and into the world.

Five hundred participants. Five hundred lives changed.

HOH Water Technology encourages all of us take that first step together. ■■■

WELCOME TO  
22 West Washington's  
"STUDIO BEE"



## Discovering the Rooftop Tenants at 22 W. Washington St.

By Kate Gawlik



Studio Bee sits on the rooftop garden at 22 W. Washington.

When considering a career as a Local 399 member on the path to becoming a chief engineer, many don't think about honey bee management. Nonetheless, Chicago is home to more than 100 active honey bee habitats, adding bee tasks to engineering worklogs.

Mike Lynch, the Chief Engineer at 22 W. Washington St., who has worked at the building for 18 years, has been thinking about honey bees since they came to the building's rooftop garden in 2019. Lynch and his team of two assistant chief engineers and four engineers enjoy this aspect of their profession.

"As a Chief Engineer, I appreciate rooftop beehives because they combine sustainability, innovation and operational pride," Lynch says. "They support urban pollination, enhance the building's environmental profile, and create a visible symbol of responsible property management."

In Chicago, honey bees play a vital role in pollinating the plants that sustain the city's local food system and green spaces. Joell Juracka, account director with the building's property manager Colliers, says, "Our building's bee program brings urban beekeeping to the heart of downtown Chicago, supporting local biodiversity while reconnecting our community with nature. Hosting hives on our rooftop helps strengthen healthy bee populations in the city."

## A Hidden Gem

Tucked among the skyscrapers of Chicago's magnificent skyline is the 17-story office structure at 22 W. Washington St, which opened in 2008. Designed by architectural firm Perkins + Will, the LEED Gold-certified building has 439,434 square feet of space. Incorporating a boutique-style concept in an office building, design priorities included being tech-enhanced, walkable, transit-connected and wellness-focused.

In Chicago, wellness has an expanded definition that takes people outdoors. With devoted urban green spaces, the lakefront and thousands of acres of parks, connecting to nature is something that Chicagoans do well. The green roof at 22 W. Washington St. adds to this concept.



Alvéole, the beekeeper company, coordinates with about 100 Chicagoland area clients for beehive maintenance to ensure thriving colonies.



Mike Lynch, the Chief Engineer at 22 W. Washington St., appreciates the rooftop beehives because they combine sustainability, innovation and operational pride.

Years after the gardens on the roof were flourishing, Colliers began considering how the green roof could be enhanced, noting the 15,856 square feet of planted area on the roof was an ideal space to bring a program for honey bees. This elevated environment offers the bees a quiet, low-disturbance home that allows them to play an active role in pollinating the urban landscape.

"Our rooftop provides a safe, carefully managed habitat where honey bees can thrive," Juracka says. "With abundant sunlight, fresh air and access to diverse flowering plants from our green roof, nearby parks, gardens, other building green roofs and balconies, the bees are able to forage across the surrounding neighborhood."

The building has two honey bee hives and one native bee home with a typical occupancy of 35,000 bees for one hive. The honey bees survived the winter extremely well and both hives are healthy with about 70,000 bees. Just as each hive is made up of different members, it takes the work of the engineers, property manager to keep the habitat thriving.

## The Busy Bees

Alvéole is an urban beekeeping company with work across the United States, Canada and Europe. In the Chicagoland area, the company coordinates with about 100 clients, including 22 W. Washington St.

Chicago is bee-friendly because it has extensive green spaces in its parks, boulevards, community gardens and tree-lined streets. The city also uses less pesticides than rural farming zones. Just like its people, the plant population in Chicago is diverse with blooms from early spring through fall. This gives bees a continuous food source until winter.

In order for bees to thrive, they need diverse flowering plants within a 2-3-mile range and water (honey bees can travel up to 3 miles to find forage). Morning sunlight is ideal, and protection

from strong winds is a must.

“Depending on the season and weather, the number of honey bees in each honey bee colony can fluctuate anywhere from a couple of thousand in the winter up to 60,000 in the summer,” says Cooper Durham, an account manager with Alvéole and the beekeeper at 22 W. Washington St.

The honey bees survived this past cold winter by working together inside the hive. Durham notes the bees form a cluster, sharing their body heat throughout the colony. They eat their stored honey until it gets warm enough to leave the hive. In February, the bee home at 22 W. Washington St. had several nested tubes that contain eggs that will hatch in the spring when temperatures consistently reach 50-60 degrees Fahrenheit.

Durham says beekeepers are onsite every three to four weeks to check the health of the hive. Their role has a lot of variability depending on the season and weather conditions.

He adds, “At some visits we may be looking for the queen, at another we could be controlling the population growth, or in the fall we will be harvesting some honey!”

Now, in the spring, beekeepers are assessing the health of their colonies to ensure that they have enough food until the flowers are in full bloom. The magic of spring gets the bees just as excited as the humans. As flowers bloom and fresh food

becomes available, the queen will be signaled to lay more eggs, growing the size of the colony and creating a workforce for the warm weather.

## Habitat Management and Education

While the hives are professionally maintained by Alvéole to ensure the bees have clean water, adequate space and protection from extreme weather, much of the bee program is operated by the engineering team.

Lynch says, “My team and I maintain the rooftop modular tray agriculture system through soil management, semiannual green roof maintenance, vegetation monitoring along with picking different varieties of sedum and milkweed to sustain a pollinator-friendly environment and the health of our rooftop bee colonies.”

The engineering team also visually inspects the hive during roof rounds, maintains clear drainage paths with no debris buildup, and confirms safe and maintained access routes to the hives. They also coordinate the set up and displays for several educational events each year.

Colliers hosts several events as part of the Honey Bee Program, like educational opportunities, locally harvested honey giveaways, and tangible ways for tenants and neighbors to engage with sustainability in action. Anchored by Earth Day



Urban beekeeping gives an elevated environment that offers the bees a quiet, low-disturbance home that allows them to play an active role in pollinating the urban landscape.



Hands-on workshops at the building include wax candle making, honey tasting and other educational activities.

on April 22, those at 22 W. Washington St. can take part in an Earth Week vendor display. This gives tenants an opportunity to see items like a hive body with frames in it, a smoker and a veil. Visitors also can scan a QR code to link to the building's myhive page, a livestream of the honey bees' habitat and activity. The engineers installed the webcam in 2020 and maintain the camera's platform and operations.

Hands-on workshops, such as wax candle making, honey tasting and other educational activations are offered throughout the year. Tenants even have the opportunity to meet the bees. Lynch adds, "We ask tenants to join us on the rooftop for a unique opportunity to meet our beekeeper and learn all about the amazing bees and their hives."

All the events are designed to deepen the tenants' understanding of how the hives support local biodiversity and why thriving bee populations are essential in urban environments.

"These programs transform sustainability into an interactive, memorable experience for our community," Juracka adds.

## Earth Day Every Day

Earth Day may be celebrated annually on April 22, but it is lived every day in Chicago through the efforts of those who support the urban landscape. If you want to talk shop with the engineers at 22 W. Washington St., Lynch and his crew are ready to review any aspect of what urban beekeeping entails, Alvéole's mission and the importance of supporting local pollinator populations.

"Training at The Union Hall doesn't necessarily teach you how to set up honey bee habitats or how to protect colonies, but Local 399 education gets you ready to expect the unexpected," Lynch says. "I've been at 22 W. Washington since the building opened, and the honey bees were a positive addition. We all enjoy checking on them and making sure they have what they need to thrive." 🐝 🐝

*Kate Gawlik is a Chicagoland area-based writer who focuses on uncovering construction and business trends.*

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All skid systems are built and fabricated at the Taco HydroFlo facility in Lubbock, Texas.

"We engineer all facets as single-source manufacturing, typically populated with — but not limited to — Taco-manufactured components such as pumps, circulators, heat exchangers, tanks, hydroseparators and domestic water pressure boosting," said Ric Turmel, SVP, Taco Engineered Building Solutions.

The new skid packages offer factory quality and reliability, reduced installation time and cost, decreased engineering involvement and design effort, space optimization, simplified project management, modularity and scalability, and safety and compliance advantages. ■■

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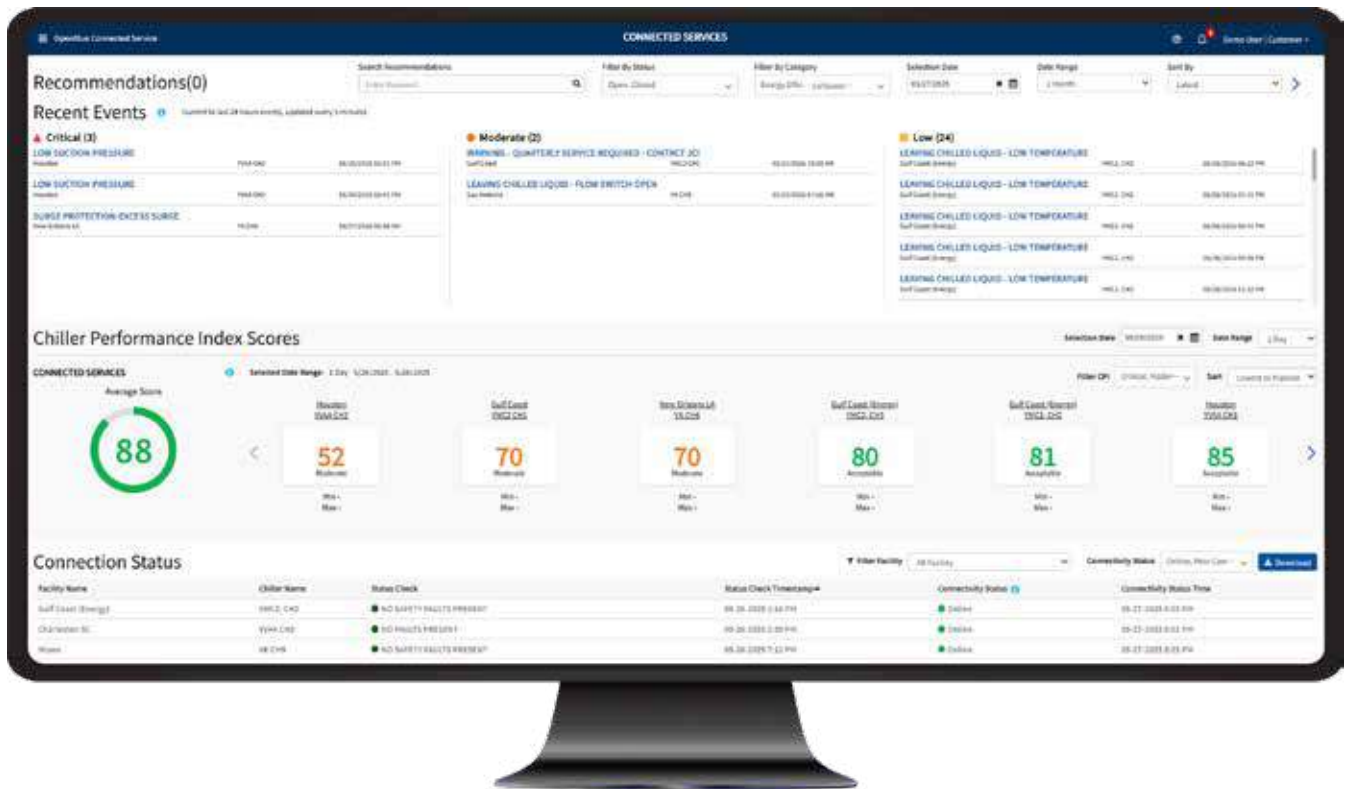
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**HOH WATER TECHNOLOGY**



Johnson Controls' Smart Ready YORK Chillers feature factory-installed connectivity to harness real-time performance insights from day one, empowering operators to validate performance baselines and monitor system health using advanced fault detection and diagnostics.

## Johnson Controls Launches Smart Ready Chillers for Day-One Connectivity, Fewer Unplanned Service Calls

Johnson Controls recently launched its next generation of Smart Ready YORK Chillers with factory-installed connectivity to harness real-time performance insights from day one. According to a recent release, the chillers enable faster remote identification of potential issues, often before they have a chance to become a problem. They also offer an average of 32 percent fewer unplanned service calls, equating to greater uptime, improved reliability and lower total cost of ownership.

Smart Ready Chillers empower operators to access critical data to set parameters at startup, validate performance baselines and monitor system health using advanced fault detection and diagnostics. This connected solution streamlines commissioning while advanced algorithms immediately begin to guide the chiller to detect even the slightest change in performance, then flag any potential issues as soon as possible to maximize uptime and operating efficiency.

Centrifugal chillers will lead the rollout of this technology with screw and scroll models to follow.

### Flexible Service, Smarter Support


Johnson Controls' Smart Ready Chillers enable digital service capabilities to meet diverse customer needs. Standard digitally enabled services include the ability to remotely gain insights coupled with on-site support — ideal for all types of customers looking to achieve more reliability, better performance and fewer operational risks.

### More Data, Faster Decisions

With more than 200 datapoints available immediately — far beyond what building automation systems typically offer — Smart Ready Chillers deliver advanced analytics enabled with AI to help operators catch issues early and to optimize ongoing performance. Even small deviations can increase energy costs over a chiller's lifecycle.

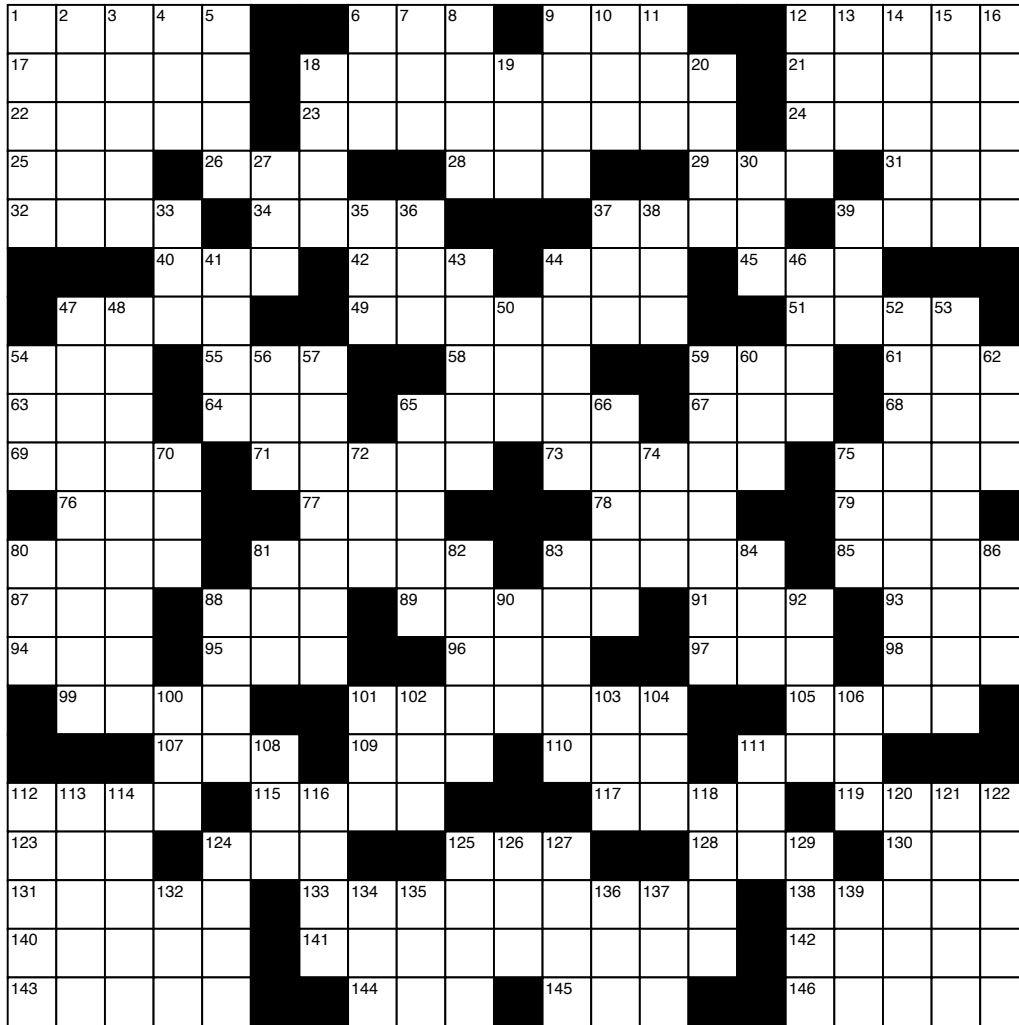
“Chillers are one of the most critical pieces of equipment in a building, and even small performance deviations can jeopardize uptime and drive-up lifecycle costs,” Tyler Smith, vice president, Global Lifecycle Solutions at Johnson Controls, said. “Smart Ready Chillers give operators the real-time data they need to maintain peak efficiency, increase uptime, reduce operating costs and extend the life of their investment, while keeping occupants comfortable.”

### Built for Lasting Impact

Smart Ready Chillers deliver more value to help building operators achieve efficiency, reliability and sustainability from the beginning. 

To learn more about Johnson Controls' innovative chiller solutions, Visit [www.johnsoncontrols.com/connected-chillers](http://www.johnsoncontrols.com/connected-chillers)





www.CrosswordWeaver.com

**ACROSS**

- 1 Lulls
- 6 Still
- 9 Tap
- 12 Hat
- 17 In a tilted position
- 18 Smocks
- 21 Ancient Greek marketplace
- 22 Mushrooms
- 23 Fond of story telling
- 24 Opp. of corinthian
- 25 Before, poetically
- 26 Pacific Standard Time
- 28 Grows acorns
- 29 Delivery service
- 31 Telegraphic signal
- 32 Frock
- 34 Tai
- 37 Cain killed him
- 39 Sieve
- 40 Key
- 42 Cry softly
- 44 Inclined
- 45 Congressional vote
- 47 Capital of the Ukraine
- 49 Neighboring area
- 51 Deride
- 54 Be victorious
- 55 Vane direction
- 58 Male parent
- 59 Not max
- 61 Married woman
- 63 Sandwich

- 64 Revolutions per minute
- 65 Small Mediterranean boat
- 67 Epoch
- 68 Saloon
- 69 Christmas carol
- 71 Lil' \_\_\_ (cartoon character)
- 73 Passes judgement
- 75 Israel's son
- 76 Ironic
- 77 Reduced (abbr.)
- 78 Alien's spaceship
- 79 Expert
- 80 Court suit
- 81 Primp
- 83 Unsuitable
- 85 Golden
- 87 Shoshonean
- 88 Chinese cooking pan
- 89 Holy person
- 91 Spoil
- 93 Downwind
- 94 And so forth
- 95 Possessive pronoun
- 96 Compass point
- 97 Meet
- 98 Anger
- 99 Tier
- 101 Cargo ships
- 105 The alphabet
- 107 Wooden leg
- 109 Frosty
- 110 Single dice
- 111 Clairvoyance
- 112 Naught

- 115 Wields
- 117 Center
- 119 Tiny spider
- 123 Roberto's yes
- 124 West northwest
- 125 American sign language
- 128 Stretch to make do
- 130 Winter mo.
- 131 Capital of Bangladesh
- 133 Chairs with side supports
- 138 Thrill
- 140 'love' (Italian)
- 141 Enigmas
- 142 Table cloth fabric
- 143 Truck
- 144 Scrambled food
- 145 Rascal
- 146 Gives the impression of being

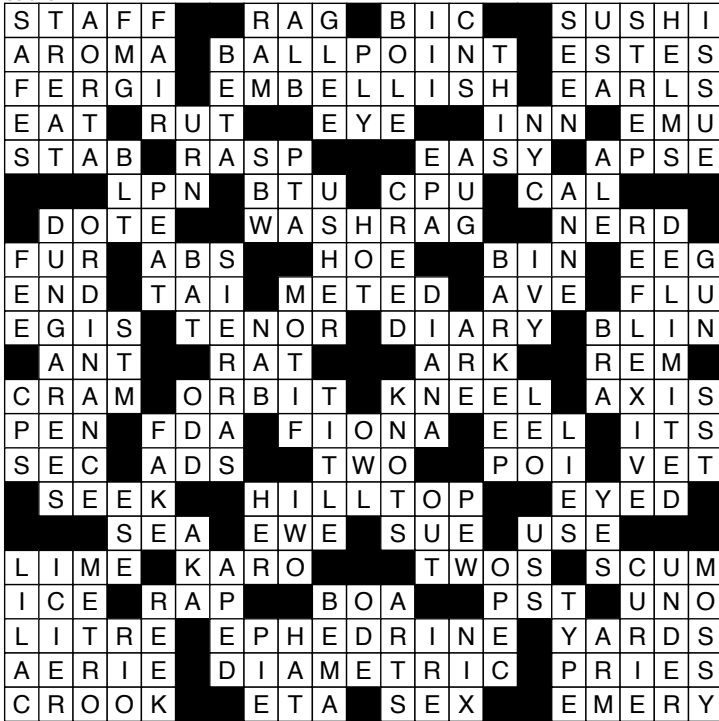
**DOWN**

- 1 Delis
- 2 Sporty car brand
- 3 Someone with no friends
- 4 Metric weight unit
- 5 Neglect
- 6 Yang's partner
- 7 East northeast
- 8 Mexican sandwich
- 9 Chess piece
- 10 Music
- 11 Legume
- 12 Podium
- 13 Pride

- 14 Musical piece
- 15 Thorn
- 16 Boat
- 18 Route
- 19 Food and drug administration (abbr.)
- 20 Swerve
- 27 Eye infection
- 30 Wooden sheet
- 33 Winter hazard
- 35 American College of Physicians (abbr.)
- 36 Note of debt
- 37 Copy
- 38 Heat unit
- 39 Spied
- 41 Maintain
- 43 Frat
- 44 Helped
- 46 Gas burner
- 47 Energy units
- 48 Cross each other
- 50 Workplace
- 52 Idiomatic
- 53 Rovers
- 54 Compass point
- 56 Hotel
- 57 Begins a journey
- 59 Autobiographies
- 60 Internal Revenue Service
- 62 \_\_\_ Lanka
- 65 Former name of Jerez
- 66 Dracula's title
- 70 Caustic substance
- 72 North by east
- 74 Spoiled
- 75 Drag
- 80 Remind
- 81 Cooking vessel
- 82 Nursemaid
- 83 Unmarried
- 84 Digit
- 86 Ball holder
- 88 Clean up a spill
- 90 Writing liquid
- 92 What Celestial Seasonings makes
- 100 Government agency
- 101 Equal
- 102 American Cancer Society (abbr.)
- 103 Flange
- 104 Body of water
- 106 Pace
- 108 Weapon
- 111 Antlered animal
- 112 Knobby
- 113 "Remember the \_\_\_"
- 114 Decoration
- 116 Played in the water
- 118 Not as much
- 120 Witless
- 121 Indian pole
- 122 Levels
- 124 Suspicious
- 125 Acting (abbr.)
- 126 Her
- 127 Revel
- 129 Snaky fish
- 132 Mongrel dog
- 134 Seed bread
- 135 Chinese flavoring
- 136 Three
- 137 Crimson
- 139 Palter

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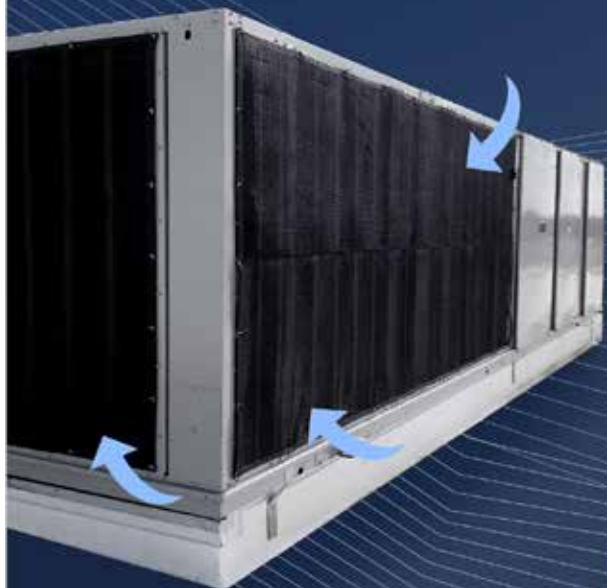


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