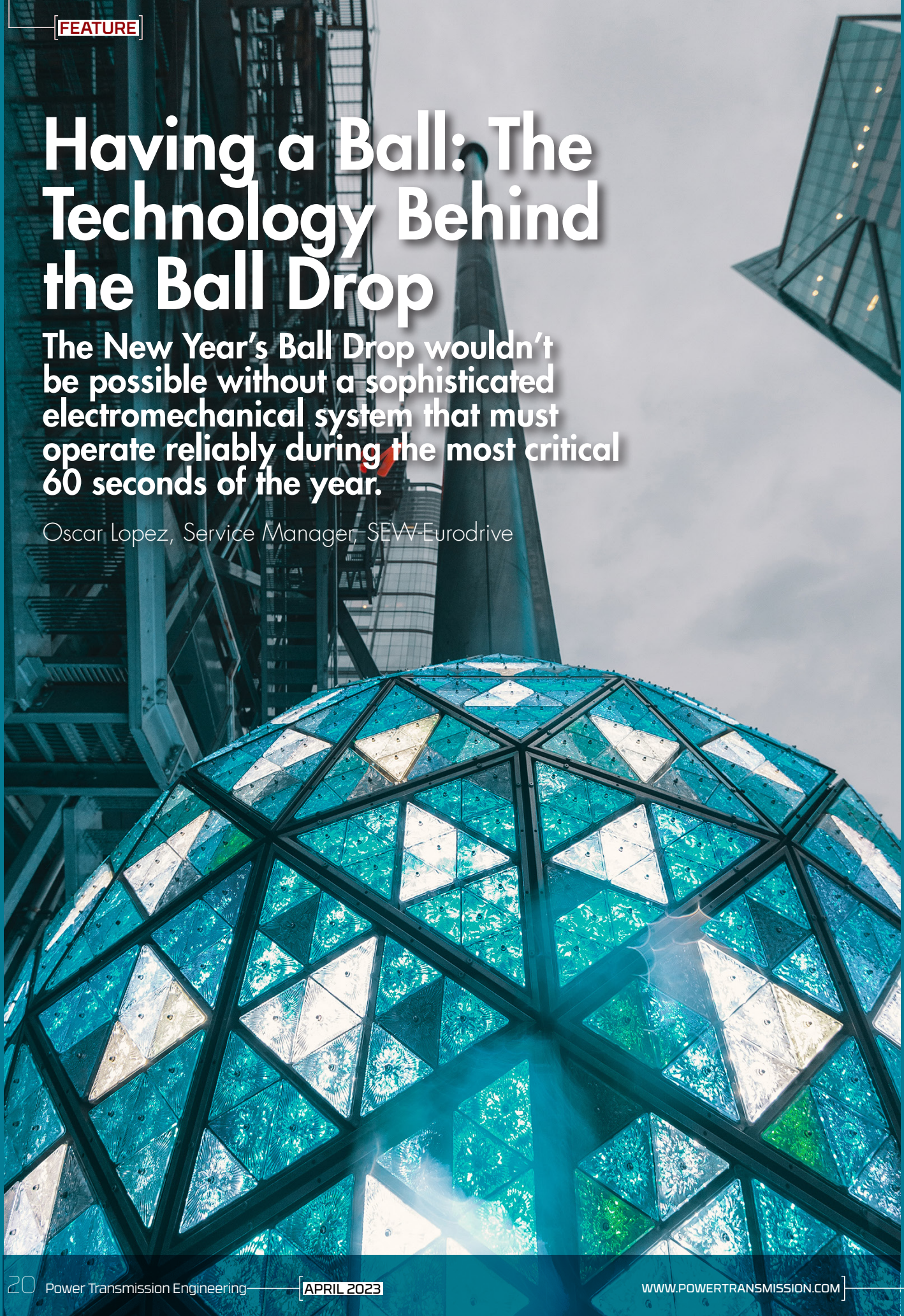
Having a Ball: The Technology Behind the Ball Drop

The New Year's Ball Drop wouldn't be possible without a sophisticated electromechanical system that must operate reliably during the most critical 60 seconds of the year.

Oscar Lopez, Service Manager, SEW-Eurodrive



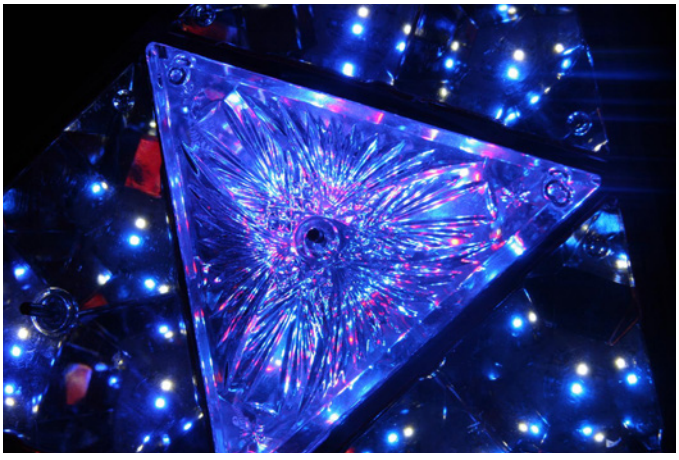
More than a billion people around the world unite to ring in the New Year, their eyes set upon the glittering New Year's Ball in Manhattan. Thousands are gathered at Times Square—the famed "Bow Tie" of Midtown—braving the December cold and peering through glasses with numerically shaped frames. Millions more tune in from their various screens at home. With so much riding on its descent, the Ball, along with the mechanical and electrical systems responsible for its operation, must operate like clockwork.

Central to its success is a powerful winch system that includes a combination planetary and helical-bevel gear unit from SEW-Eurodrive. This unit—which runs at 7.5 rpm with a 235.89 gear ratio, output torque of ~31,500 pound-inches (lb-in) and 40 hp brake motor—joins a sophisticated set of subsystems that work together to raise and lower the 11,875-pound Ball, making the New Year celebration possible.

About the Times Square Big Ball

Responsible for this seventh and latest iteration of the Ball, including its structural engineering, mechanical design, systems integration, light fixturing and rigging, is Hudson Scenic Studios (hudsonscenic.com), a specialist in custom fabrication, automation and bespoke finishes for the entertainment and architectural industries.

Constructed in 2008, this Ball is twice the size and three times as bright as the preceding Centennial Ball. A geodesic sphere with a 12-foot diameter, the Big Ball features 2,688 Waterford Crystal triangles that are bolted to 672 light emitting diode (LED) modules. Each module, which is attached to the Ball's aluminum frame, contains 48 red, blue, green and white LEDs, totaling 32,256 lights that can create millions of color combinations and kaleidoscope patterns.



The Big Ball features 2,688 Waterford Crystal triangles.

On December 31st at 6:00 p.m. EST, this Big Ball—as it has done for over a decade—rose to the top of its 130-foot mast in One Times Square, where the Ball resides year-round. Then, at 11:59 p.m., it began its 75-foot descent, the timing of which was tied to a global positioning system (GPS).

When the countdown hit zero, the Ball dropped behind the seven-foot-tall New Year numerals shining above Times Square. Its lights turned off, and the 2023 numerals, along with the New Year itself, were suddenly brought to life.

"In that moment, the whole world unites," said Jeffrey Straus, president of Countdown Entertainment, LLC, the co-organizing company behind the Times Square Ball Drop.

The Ball's Permanent Home

Built in 2007 to commemorate the Times Square Ball Drop's 100th Anniversary, the Centennial Ball was the first design to incorporate LED technology instead of incandescent and halogen bulbs. Its elegance and energy efficiency inspired Jamestown LP, the owner of One Times Square, to commission the construction of the current Big Ball, which remains a permanent, sparking fixture in Times Square all year long.

The Winch System and Gearmotor

For 87 years following the first Ball Drop in 1907, the Ball was raised and lowered by six men with ropes and a stopwatch—a solution that is far from practical, if even possible, for the current six-ton Ball. "Although it operates on a limited basis, the Ball must always remain functional," said Brant Underwood, senior project manager at Hudson Scenic Studios.

Whether the Ball is descending on New Year's Eve or serving as a backdrop for tourist photos the rest of the year, its full weight—including the LED modules, aluminum frame and electrical system at its center—is supported by a powerful winch system. Designed for inverted mounting below the mast platform, this winch includes a two-line system and 42-inch drum with helical grooving. Two 3/4-inch wire ropes, which connect to the Ball, wrap around the drum in opposing directions, maximizing handling control and keeping the winch system as compact as possible.

Also hooked up to the drum is the SEW-Eurodrive gearmotor that holds the weight of the Ball at full torque. The machine incorporates a planetary and helical-bevel gear, AC motor, encoder and brake. A closed loop regenerative variable frequency drive (VFD) uses the encoder to provide highly accurate speed control of the motor. According to Underwood, this regenerative VFD is what turns the winch "into a kind of generator" during the 60-second Ball Drop. "As it resists the load of the Ball during the 75-foot descent, the regenerative system pushes power back to the electrical grid," Underwood added.

A gearmotor is a combination gear unit and motor, usually an AC or servo motor. Its central function, which is performed by the gear unit and its gear unit stages, is to transmit the motor's force from the input end to the output end, thereby acting as a kind of converter of speed and torque. In most applications, the gear unit slows down the motor's rotational speed while at the same time transmitting higher torques than what the electric motor can accomplish on its own.

The SEW-Eurodrive gearmotor incorporates two gears—a planetary gear that produces most of the required torque for the Ball application, as well as a helical-bevel gear. Other components include an AC motor, encoder, and rectifier brake.

The powerful winch system supports the Ball's full weight—including the LED modules, aluminum frame and electrical system—all year-round.

A Monumental Feat in Welding

During the Ball's construction in 2008, various metalworkers, welders, fitters, finishers, machinists and assemblers clocked in more than 3,000 hours of labor, earning the Ball the American Welding Society's Extraordinary Welding Award in 2014. This award, which is given to welded structures with historical importance, celebrated the Gas Tungsten Arc Welding (GTAW) process that was utilized in the Ball's aluminum frame construction. In particular, workers arranged the structure into 180 triangular faces, each of which was made from 4-inch-diameter tubes and welded together via GTAW.

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Transporting the Massive Mast

According to the Hudson Scenic team, the Ball's 130-foot mast was one of the largest pieces of steel to ever enter New York City. The mast, which was pre-rigged with all the necessary cable management components, was brought across the George Washington Bridge after midnight on the back of an articulating dolly trailer.

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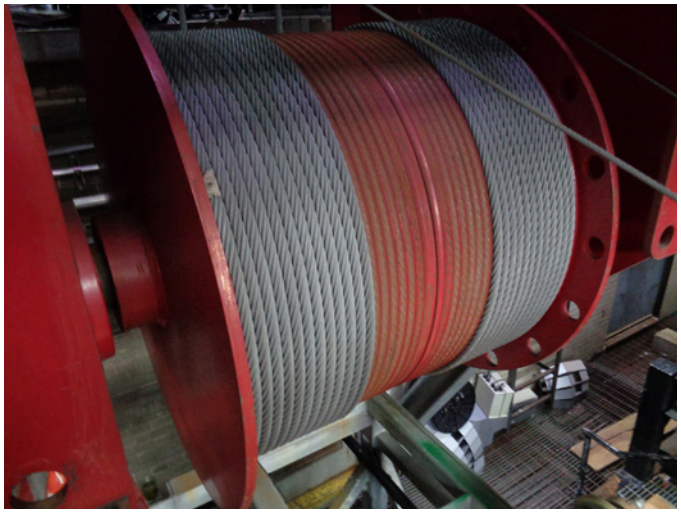
Essential to the winch system is the SEW-Eurodrive gearmotor.



The winch also includes two ¾-inch wire ropes that wrap around the drum.

Rounding out the winch system is a programmable logic controller (PLC) for controlling all the movements, as well as roughly 20 to 30 multiconductor cables that supply power and data to the whole system. Operators can control the Ball using either a local controller or the human machine interface (HMI) on the 22nd floor of One Times Square.

"The local controller is a secondary interface that acts as a redundancy," Underwood said. "Using a handheld device, we can go out onto the roof and raise or lower the Ball from there."

Remote Control Means More Safety

Because the roof of One Times Square contains various signs, railings and other building appendages, the ability to control the Ball remotely creates a critical failsafe. "It can be a tight space up there," Turnstall says. "Sometimes there's only a foot of space between the Ball and other building elements. If the Ball descends too low, for example, we need a way to stop it before it hits something and cracks a crystal. Having this ability to control the Ball remotely means there are more eyes on it, ensuring it's handled and treated with the utmost of care."

Along this topic of safety, the Ball includes an emergency (E)-stop function, as well as various subsystems and I/O control that enable operators to monitor aspects of the Ball's position and operation. Examples include the ability to monitor the Ball's power, as well as sensors that will alert operators if the main disconnect switch turns off.

Improving the Ball's Reliability Through Routine Servicing

Times Square is one of the most frequently photographed buildings in New York City. "This fact makes routine maintenance critical for the Ball's ongoing operation, as well as for the forward-facing presentation of the building," says Ryan Tunstall, senior vice president of development and construction at Jamestown, L.P., which owns One Times Square.

To ensure the winch system will perform its annual duty, the Ball is raised and lowered roughly once a month. SEW-Eurodrive technicians also come in and provide regular inspections of the gearmotor.

The Ball is in good hands. We drain the oil, inspect the internal components of the gearbox, and analyze the oil samples in a lab. The elemental analysis tells us whether there's any abnormal wear taking place in the equipment. We often apply these same maintenance techniques to other machines.

The gearbox—which was recently serviced by SEW-Eurodrive technicians in early December 2022—has very minimal wear and tear. As the unit ages, the plan is to "be more aggressive" in terms of making technical recommendations.

Fortunately, the gearmotor doesn't need extensive servicing due to its limited operational frequency. Because of the low duty cycle, the gearbox rarely experiences a significant rise in temperature, which has a direct effect on the health and longevity of the equipment.

To 2023—and Beyond

According to Straus of Countdown Entertainment, the Ball, with a billion eyes on it each year, depends on the gearmotor and winch system to ensure the New Year starts. "One year, when the Ball was still controlled by ropes, a person even got tangled up, causing the Ball to stop halfway through its descent and delaying the New Year," Straus said with a chuckle. "Thanks to the winch system, we've never had an issue."

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