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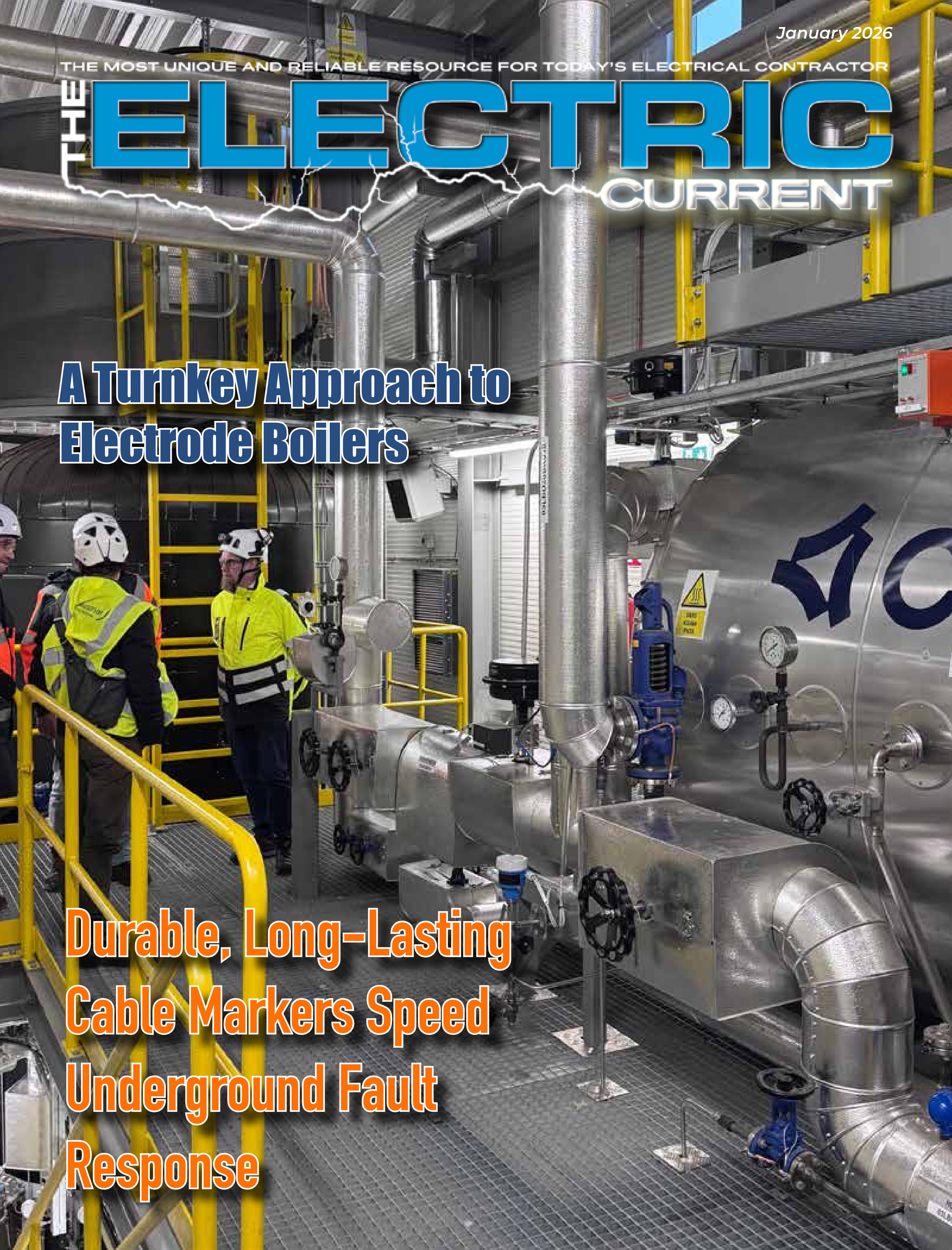

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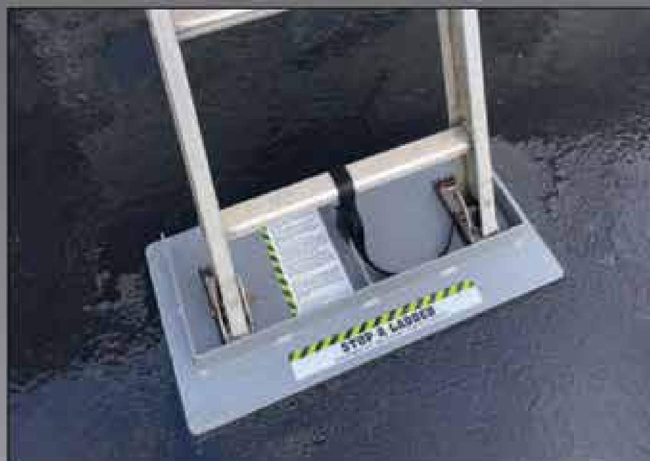

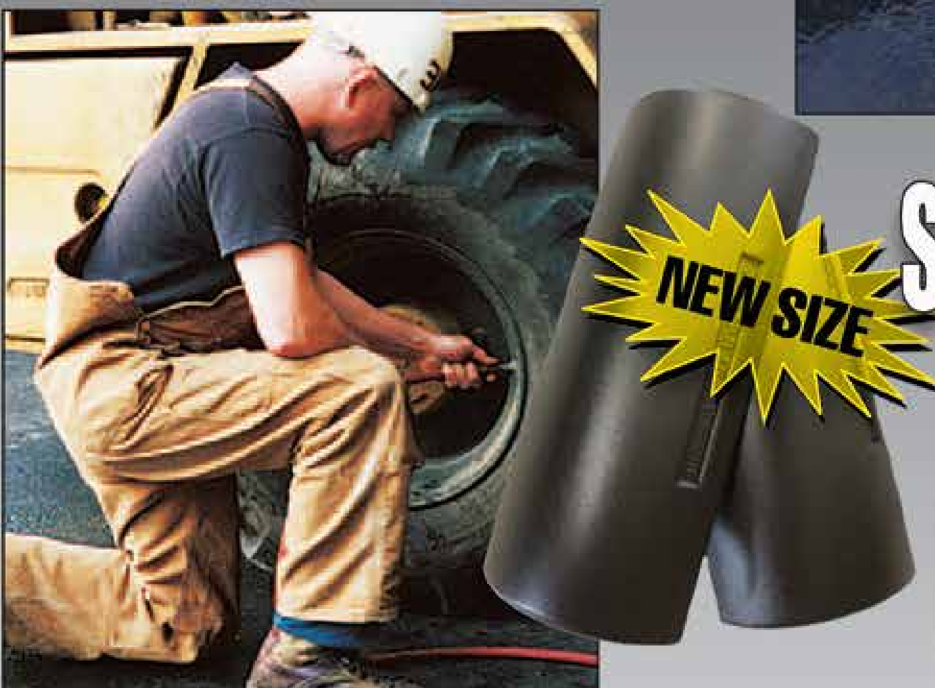

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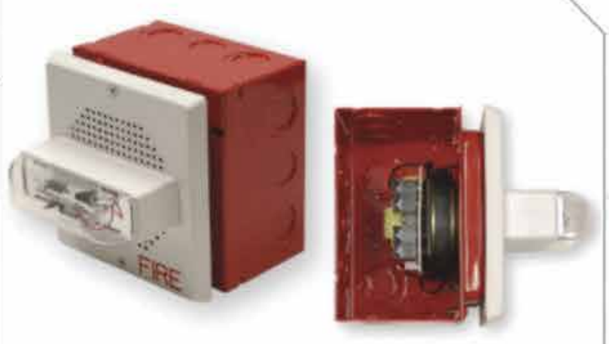

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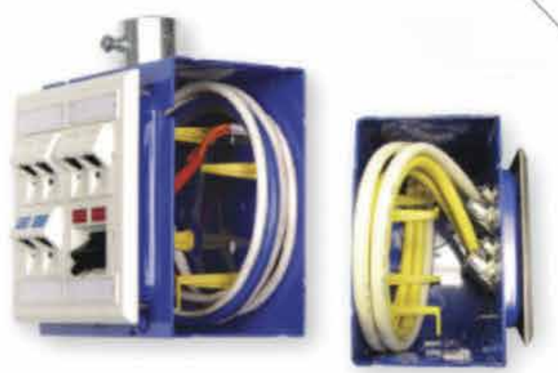

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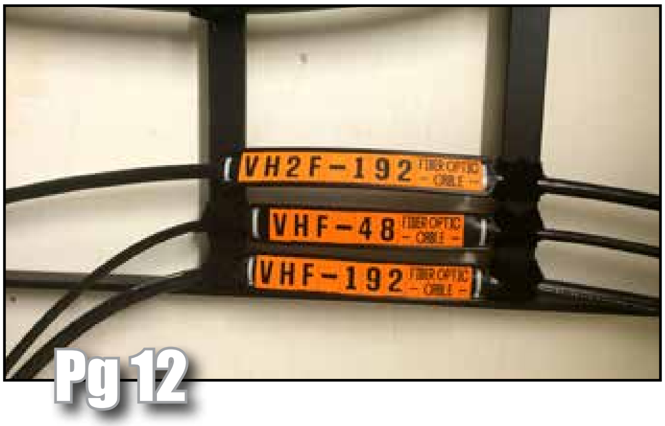

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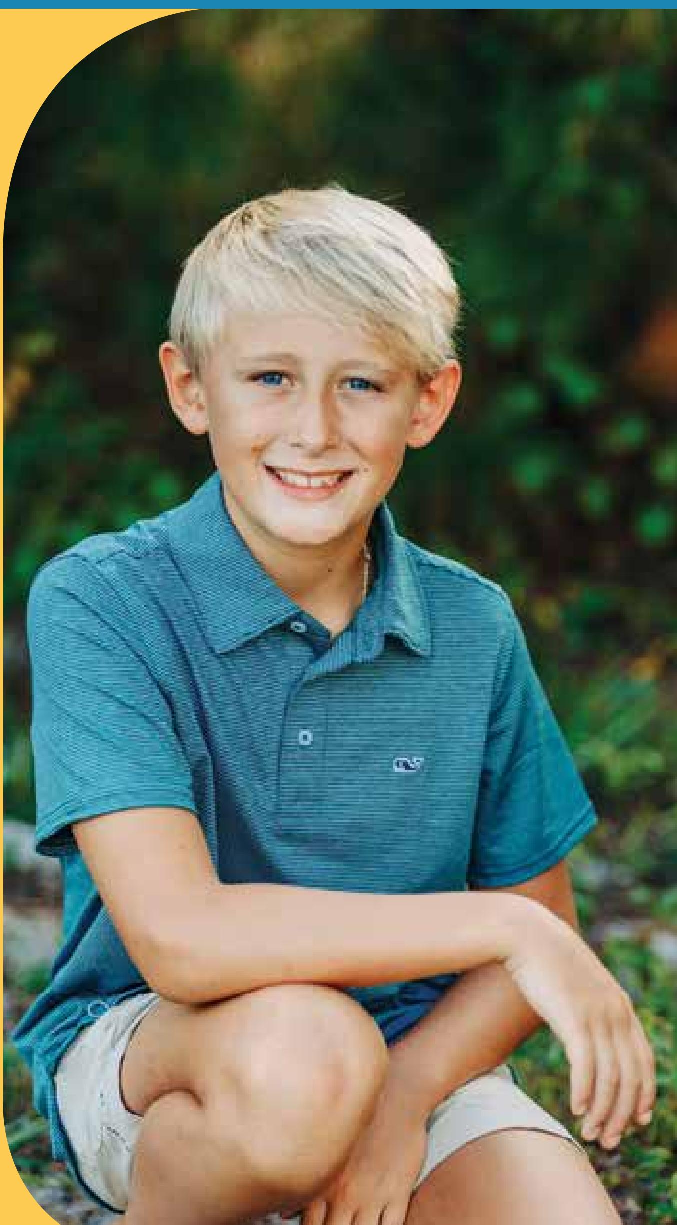

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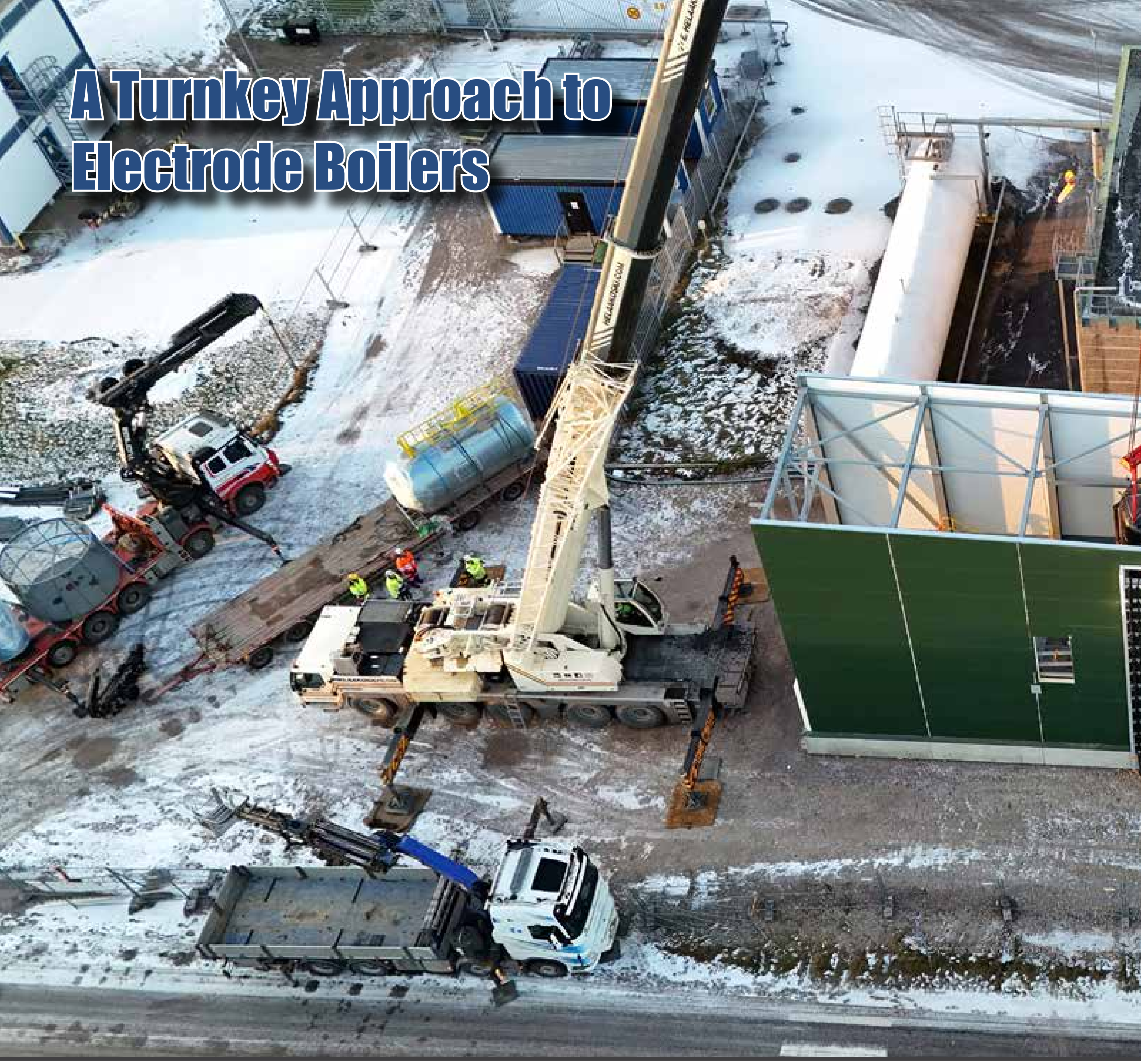
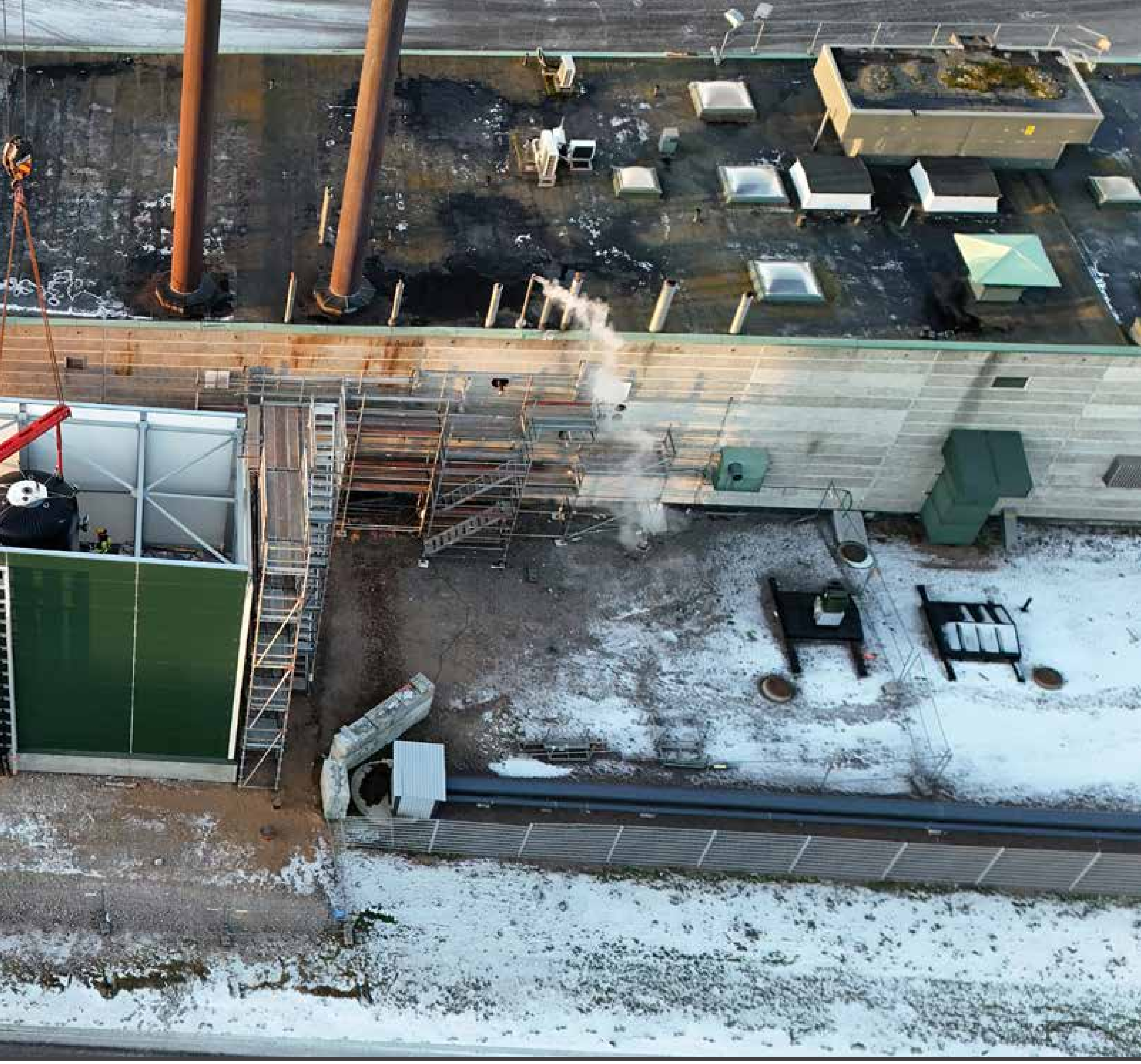
A Turnkey Approach to Electrode Boilers



Turnkey boiler systems avoid the risks and complexities that come with a boiler overhaul. Using modular parts streamlines the process even further.

Modern high-output electrode boilers are redefining how industrial facilities and district heating networks generate steam and hot water. Designed to operate using high-voltage electricity, today's systems can deliver output capacities of up to 68 MW and steam pressures reaching 39 barg, placing them firmly in the range traditionally occupied by large fossil-fired boilers.

As demand for electrification increases, however, the technology itself is no longer the primary challenge. Instead, attention is shifting toward how these systems are delivered, integrated, and operated. It is increasingly uncommon for electrode boilers to be purchased as standalone pieces of equipment. Instead, projects are typically executed by third-party



contractors responsible for full system integration, reflecting the growing complexity of modern boiler installations.

In many cases, an EPC contractor is appointed to oversee the full scope of work, covering engineering, procurement, and construction. Certain elements, such as process design and the development of building layout and architectural concepts, are handled internally, while the remaining work is performed by specialized subcontractors for piping installation, electrical work, and structural fabrication.

Now that model is increasingly being replaced by single-source providers that perform all the work in-house, delivering fully integrated turnkey solutions. These offerings include the boiler along with all ancillary equipment necessary for installation and may be constructed directly at the site or delivered as prefabricated units for rapid assembly.

These modular designs can reduce project time from months to just a few weeks while also reducing overall costs. By limiting on-site work, they avoid the complexity and expense of installing equipment in existing spaces crowded with piping and steel structures.

"Designing and building a new boiler house off-site allows the work to be completed more efficiently," says Juha Mäntynen, Chief Executive Officer of CT Industrial Oy (CTI), a Finland-based CleanTech provider specializing in turnkey, zero-emission, high-efficiency energy systems, including high-voltage electrode boilers for industrial and district heating applications across 19 European countries.

"All the steel structures for the building, concrete work, pipe assembly, electricity, and control systems—everything is included," adds Mäntynen, adding that at CTI, this requires an in-house team of approximately 35 fitters and welders responsible for fabrication and installation work, along with engineers for overall project management, both process and mechanical engineering, automation, and electrical systems and commissioning.

Turnkey delivery allows customers to take a largely hands-off approach to boiler upgrades, avoiding the complexity and coordination burden typically associated with large infrastructure projects.

"This method is less risky," Mäntynen says. "The customer doesn't need to commit employees to a project management group. They can focus on their own business and manage this kind of project with just a few people. Having one fixed price also makes budgeting easier."

The Boiler Defines the System

According to Mäntynen, the scope of a project depends on the customer's existing infrastructure and available space. Some facilities already have a building prepared for the boiler installation, while others do not.

When a project involves an existing building, a plant manager typically allocates a designated space for the boiler system. CTI begins by conducting an on-site assessment and performing a detailed 3D scan of the room. This scan is converted into a digital model, allowing the boiler and associated equipment to be accurately fitted within the available space.

In situations where no existing structure is available, CTI can assume responsibility for both the design and construction of the facility. Under this approach, the process begins with the architectural and engineering design of the boiler house.

The boiler type and its specific use for hot water or steam generally determine the overall layout and dimensional

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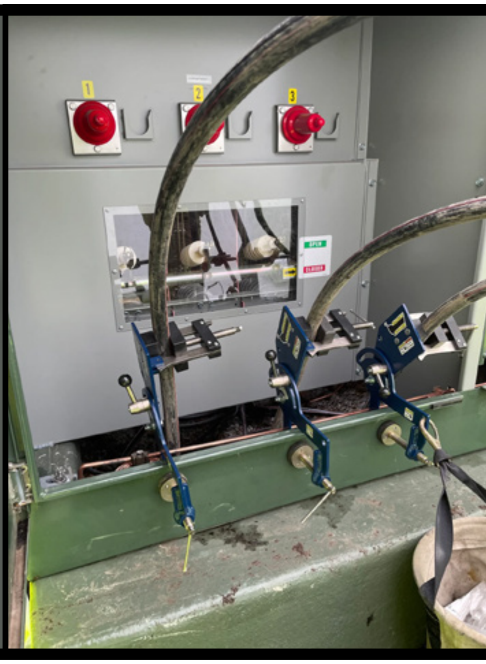

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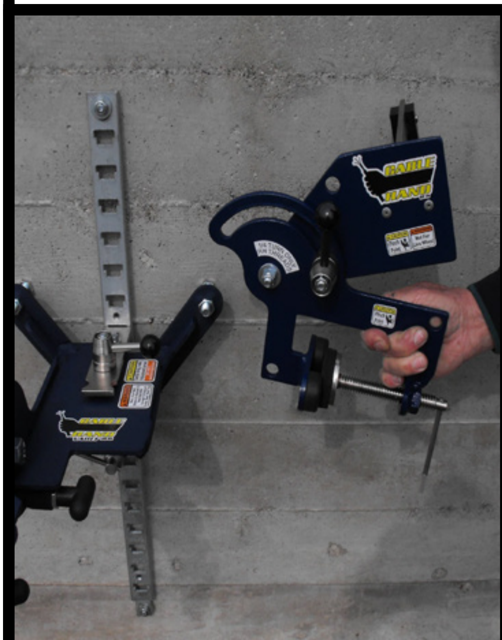

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Hot water systems require fewer components, whereas steam boiler installations involve additional subsystems such as feedwater systems, pump feeds, pressure-reduction equipment, and water-treatment systems.

For the electrode boilers, CTI partners with North America-based Acme Engineering, a manufacturer of industrial and commercial boilers, to provide high-voltage electrode boilers to the European market.

The electrode boilers are offered in horizontal configurations with capacities typically reaching approximately 10 to 12 megawatts. When higher output is required, a vertical configuration becomes necessary, which directly affects overall unit height. Horizontal models provide a compact profile, generally limited to about 3.5 meters in height, whereas vertical models commonly range from six to eight meters tall.

Electrical infrastructure must also be addressed. While customers typically supply a main transformer to power the boiler, contractors can assume responsibility for this as well. This could include a complete electrical system, starting with a 110 kV high-voltage supply that steps down to 20 kV, with all necessary switchgear.

In an electrode boiler system, a low-voltage transformer is typically required to supply power for control and automation systems such as PLCs, instrumentation for temperature, pressure, flow, and water conductivity measurement, human–machine interfaces, safety interlocks, alarm systems, and control circuits for auxiliary equipment such as valves and pumps.

A Modular Approach

While integrating new equipment into existing facilities may appear advantageous, such environments often contain extensive piping, steel structures, and other constraints. These limitations restrict layout options and typically require substantial on-site modifications, leading to increased installation complexity, longer schedules, and higher overall costs.

By contrast, a prefabricated boiler house provides significantly great-

er flexibility and efficiency. Full control over the layout enables the system to be optimized from the outset, including the strategic use of modularization and prefabrication to reduce site work, improve quality, and streamline installation.

In many cases, the complete hot water or steam boiler system can be assembled in CTI's facility as a single module similar in size to a shipping container. Factory-built modules reduce overall cost, require less on-site space, and significantly simplify installation. All piping connections, alignment verification, and functional testing are fully completed before the unit is transported.

These modular solutions are suitable for both steam and hot-water applications and can be implemented in either horizontal or vertical configurations. For applications where ceiling height is restricted or overall system dimensions must comply with shipping limitations, a horizontal unit may be indicated.

Mäntynen says Acme Engineering is unique in offering a horizontal hot water boiler design that is particularly well-suited for retrofit projects.

Acme Engineering also offers vertical boilers including the jet boiler, capable of handling higher pressures with zero to 100 percent modulating capacity, and the immersed electrode boiler, which can be configured for either hot water or steam applications.

According to Mäntynen, in a recent project the complete boiler structure built around a horizontal unit from Acme Engineering that measured approximately 19 meters in length, 7.5 meters in width, and 6 meters in height. For larger installations, the boiler system can be divided into multiple transportable sections that are shipped worldwide and require only minimal on-site assembly.

In another example in a large cheese manufacturing facility in Valio Haapavesi, the existing boiler room had no available space for the new equipment. As a result, a boiler building was constructed next to the original. The existing and new systems were then connected by a dedicated piping run to balance and operate both as a single plant.

CTI is in the early stages of expanding this approach for electric boilers, but market interest is already strong. Mäntynen says EPC contractors across Europe are turning to CTI for modular boiler installations, as are customers looking to reduce costs.

"We have customers who are very interested in this approach because the transportation cost for a big boiler house is very high, and with the prefabricated modules, we can cut that price to one third," states Mäntynen.

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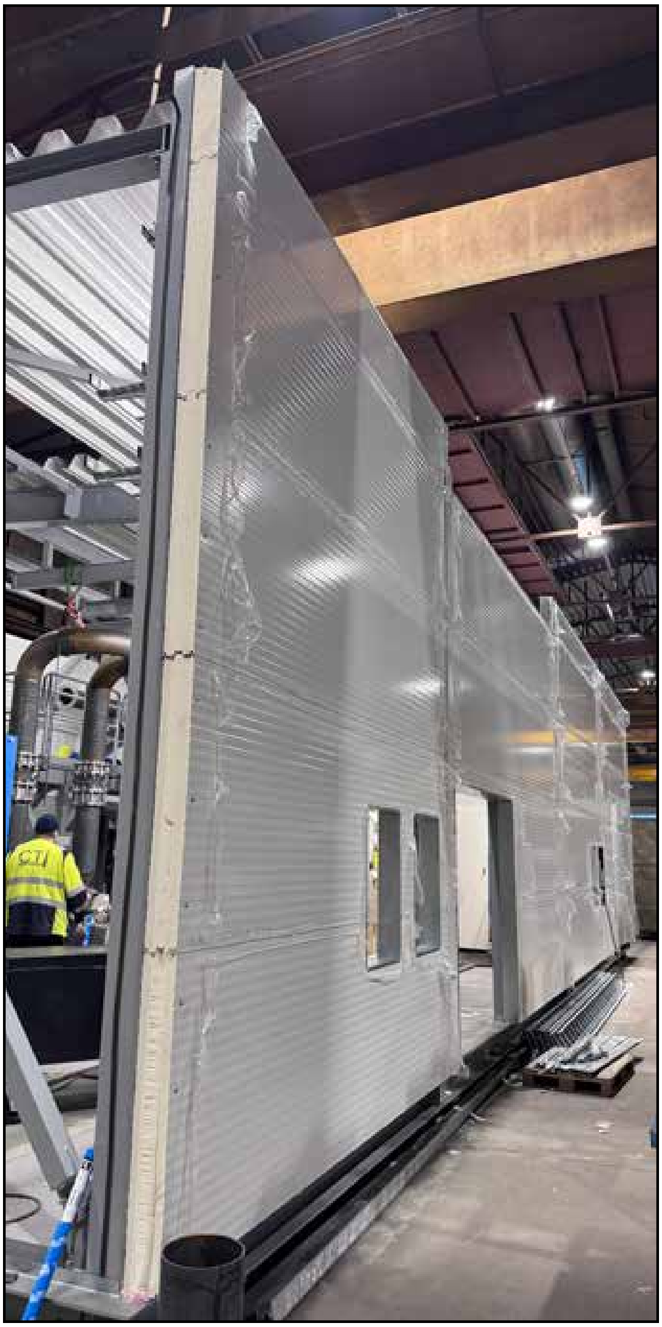

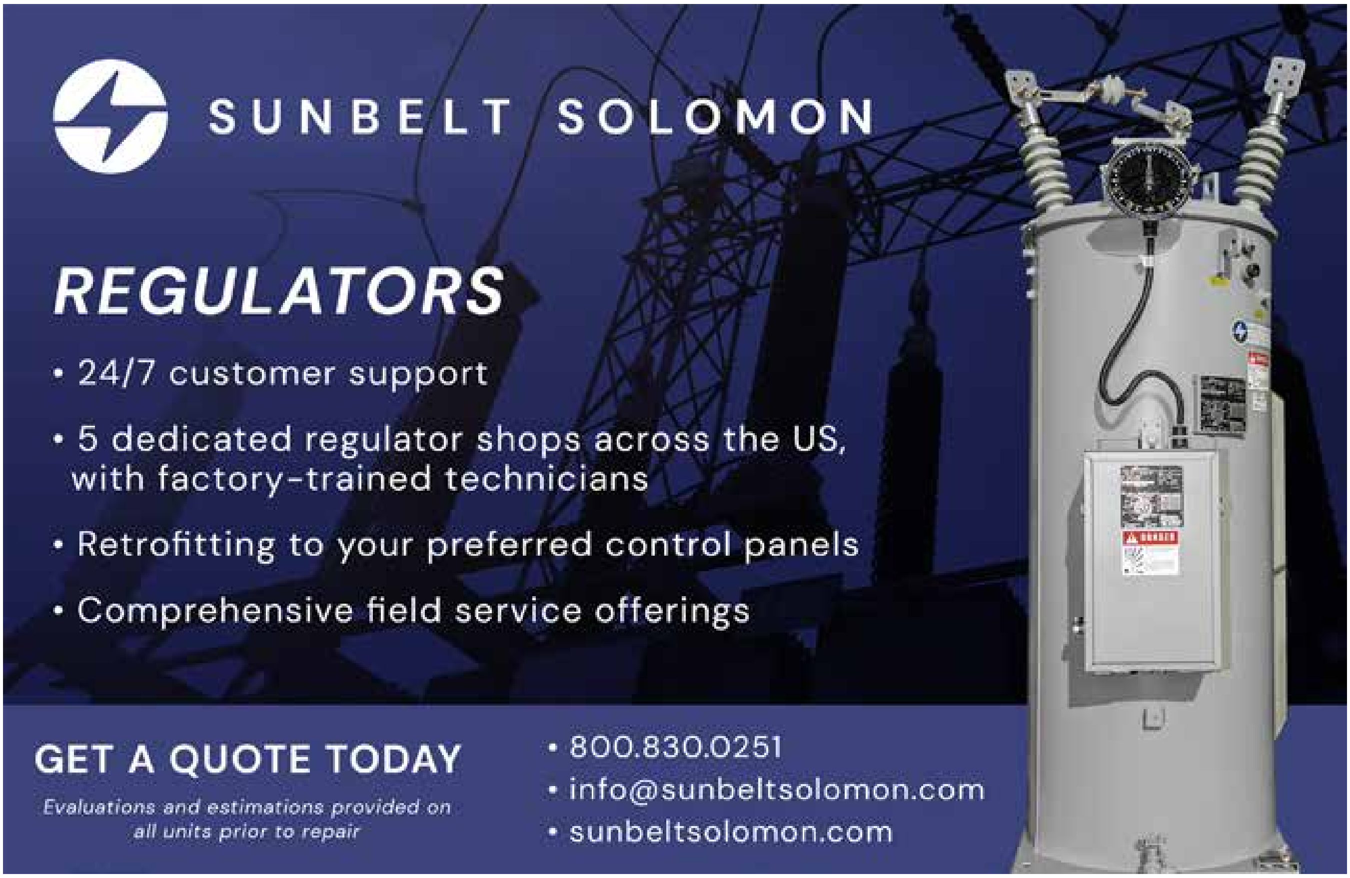
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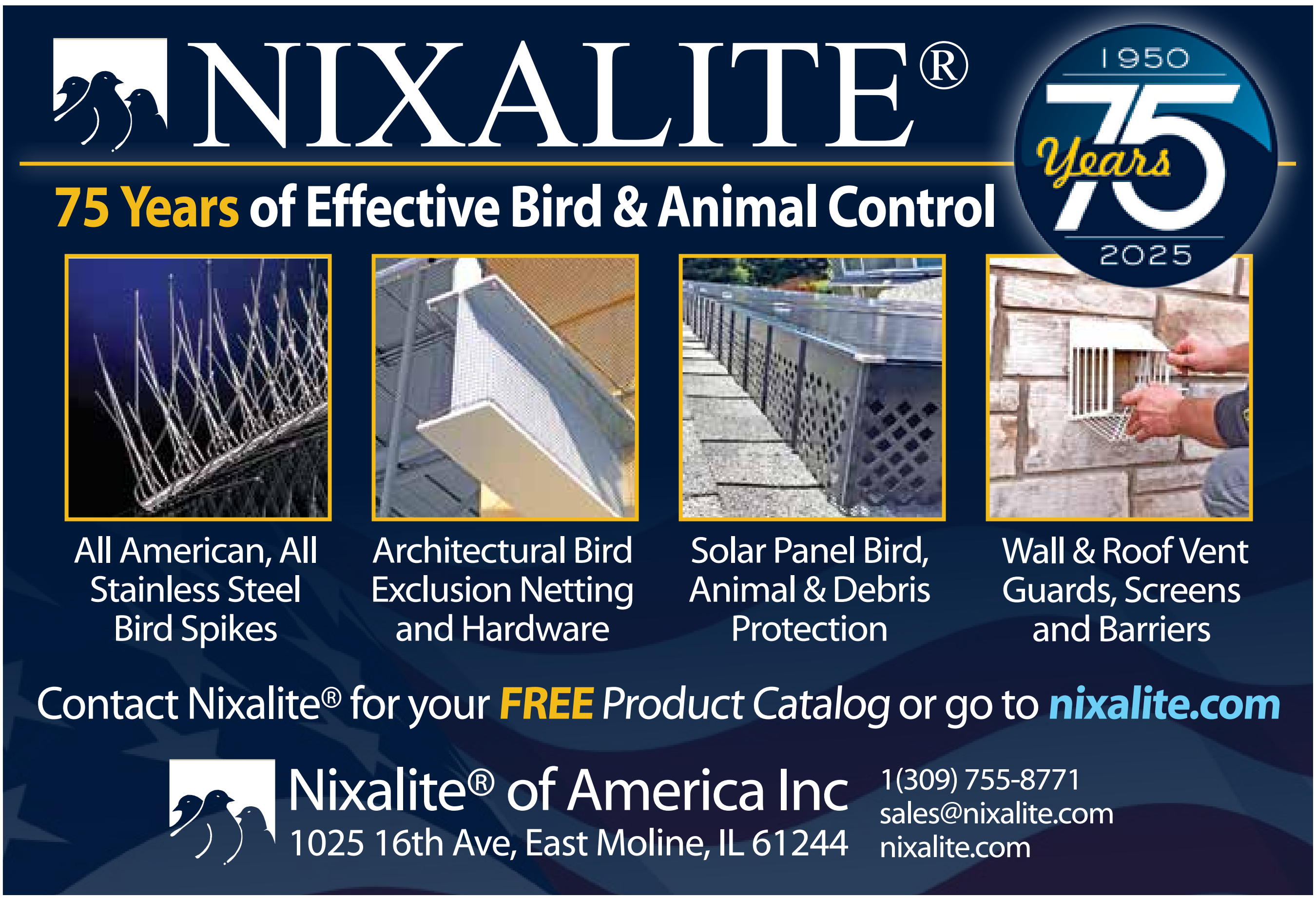
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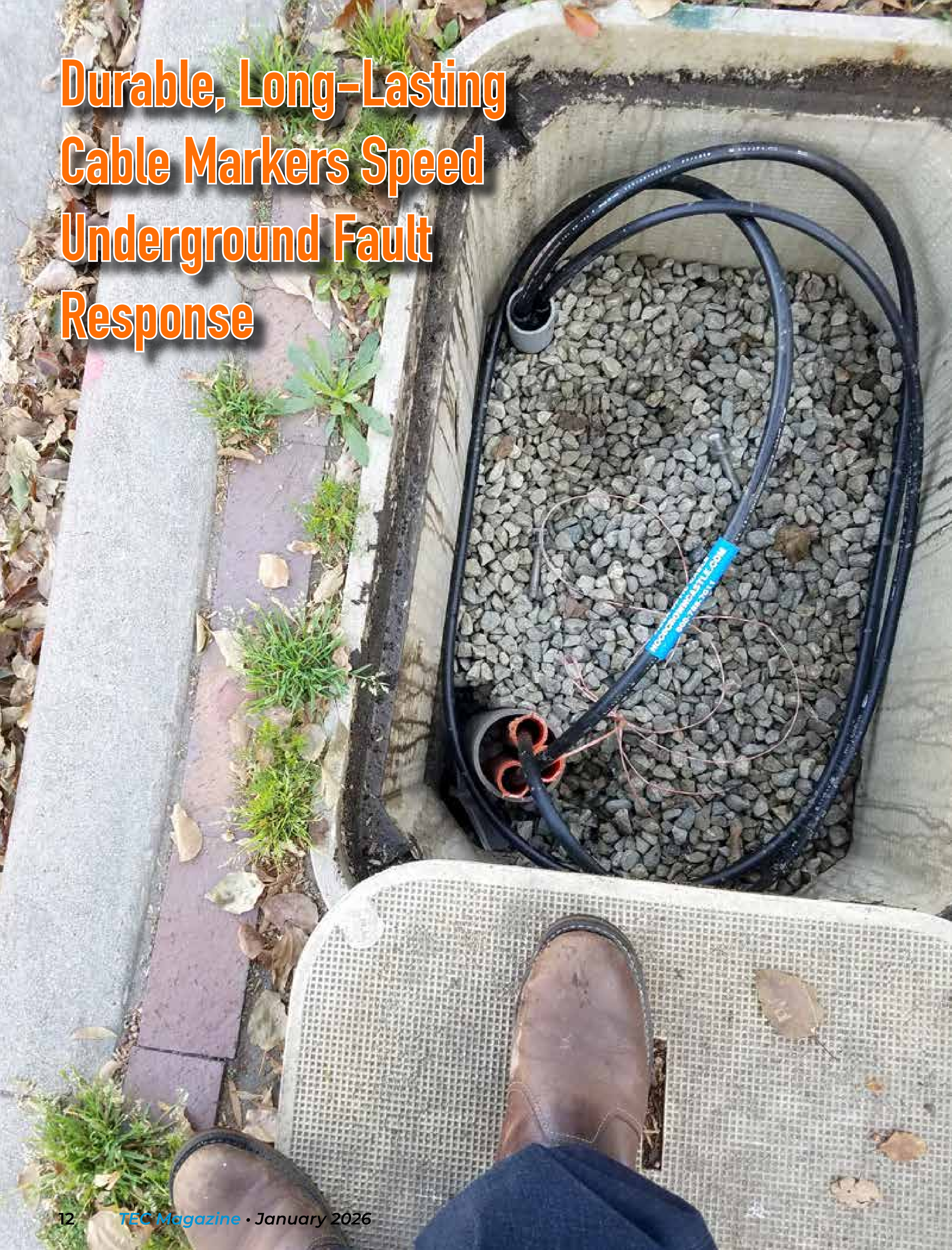


In underground electrical systems, accurate and visible tags and markers are essential for locating faults quickly and safely.

For electric utilities, even brief power outages can disrupt homes, businesses, and critical infrastructure. These interruptions can also impact public safety and diminish customer trust, so quickly identifying and resolving electrical line faults is essential.

The challenges can be even greater with underground systems that distribute electricity through cables buried below ground. Unlike overhead lines, underground cables are not easily accessible. When a fault occurs, locating and repairing the problem often requires specialized tools and possibly excavation. Even minor failures can turn into extended outages.

To identify the probable location of the fault, linemen rely on data such as feeder loads, breaker activity, and SCADA information before going out into the field to make repairs. However, this is where the work becomes more challenging. Physical signage at the site is a critical tool for directing utility crews to the precise location of underground cables, access points, and other infrastructure so the work can begin.

Therefore, when cable markers are missing, mislabeled, or damaged, the entire fault-response effort is delayed. Dispatchers often require more time to narrow down the field location. Technicians must wait for updated locations. Electromagnetic detection, ground-penetrating radar, and vacuum excavation may be required.

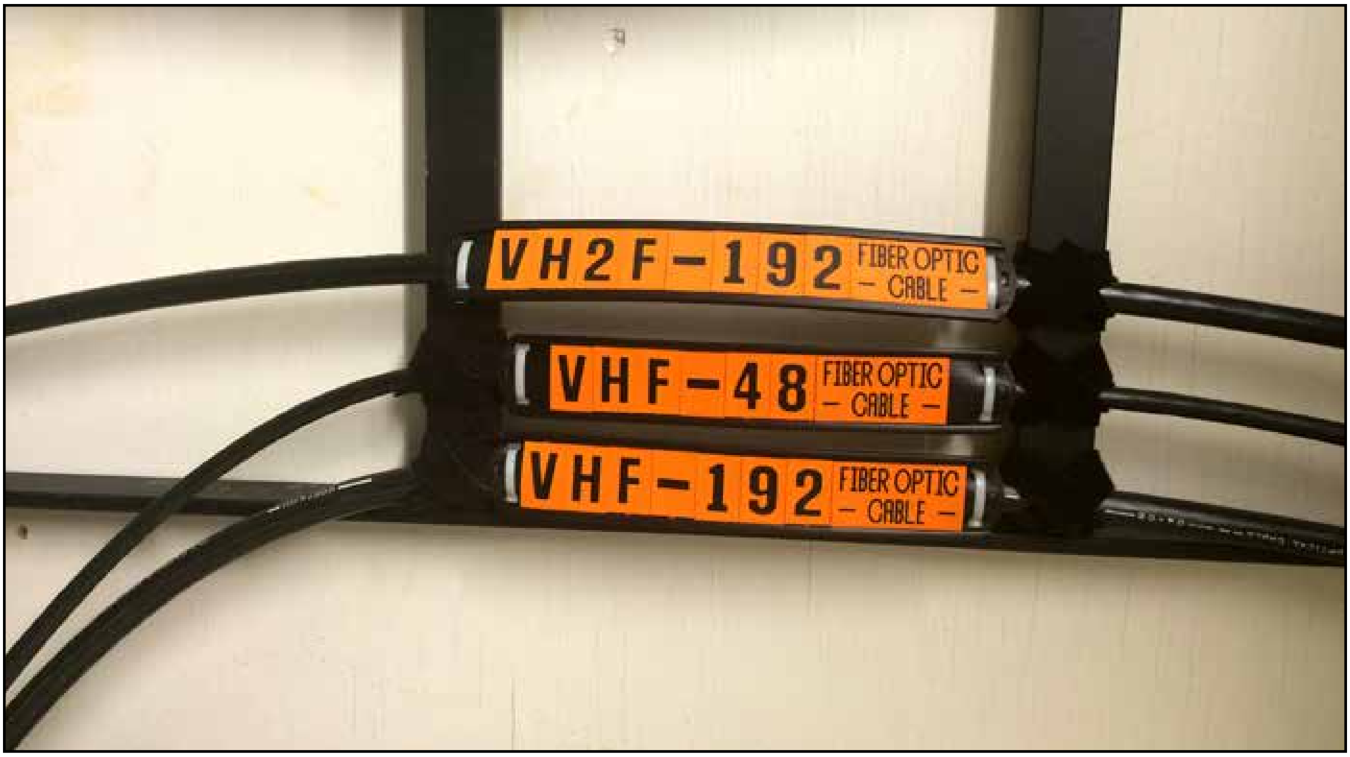
This underscores the importance of signage that is accurate, visible, and legible over many years, despite the harsh underground environment.

“Cable tags and markers play a critical role in warning utility personnel about potential hazards, but also can help utilities minimize any downtime by facilitating the location of cables and other equipment underground faster,” explains Daniel O’Connor, General Manager of Tech Products, Inc., a New York-based manufacturer of industrial identification solutions with over 75 years of experience.

O’Connor emphasizes that markers that are “good enough” for a few years may be slightly less expensive but are ultimately poor choices in the long run.

“The graphics should remain highly visible and legible for thirty to forty years after installation, even in harsh environments above and below ground,” says O’Connor.

Signs Everywhere
In underground electrical distribution systems, signage must be installed in several critical locations. The rules for signage are largely derived from OSHA regulations, the National Electrical Safety Code



(NESC), the National Electrical Code (NEC), and ANSI standards for safety signage. Utilities also maintain their own detailed signage and labeling standards that often exceed the general codes

Above ground, labels are posted on transformer enclosures, switchgear, cable risers, junction boxes, and utility access points. Common warning signs include "DANGER: High Voltage," "Underground Electric," and "Authorized Personnel Only." Pad-mounted transformers and sectionalizing cabinets must include an equipment ID number, voltage and phase information, kVA rating, and manufacturer information.

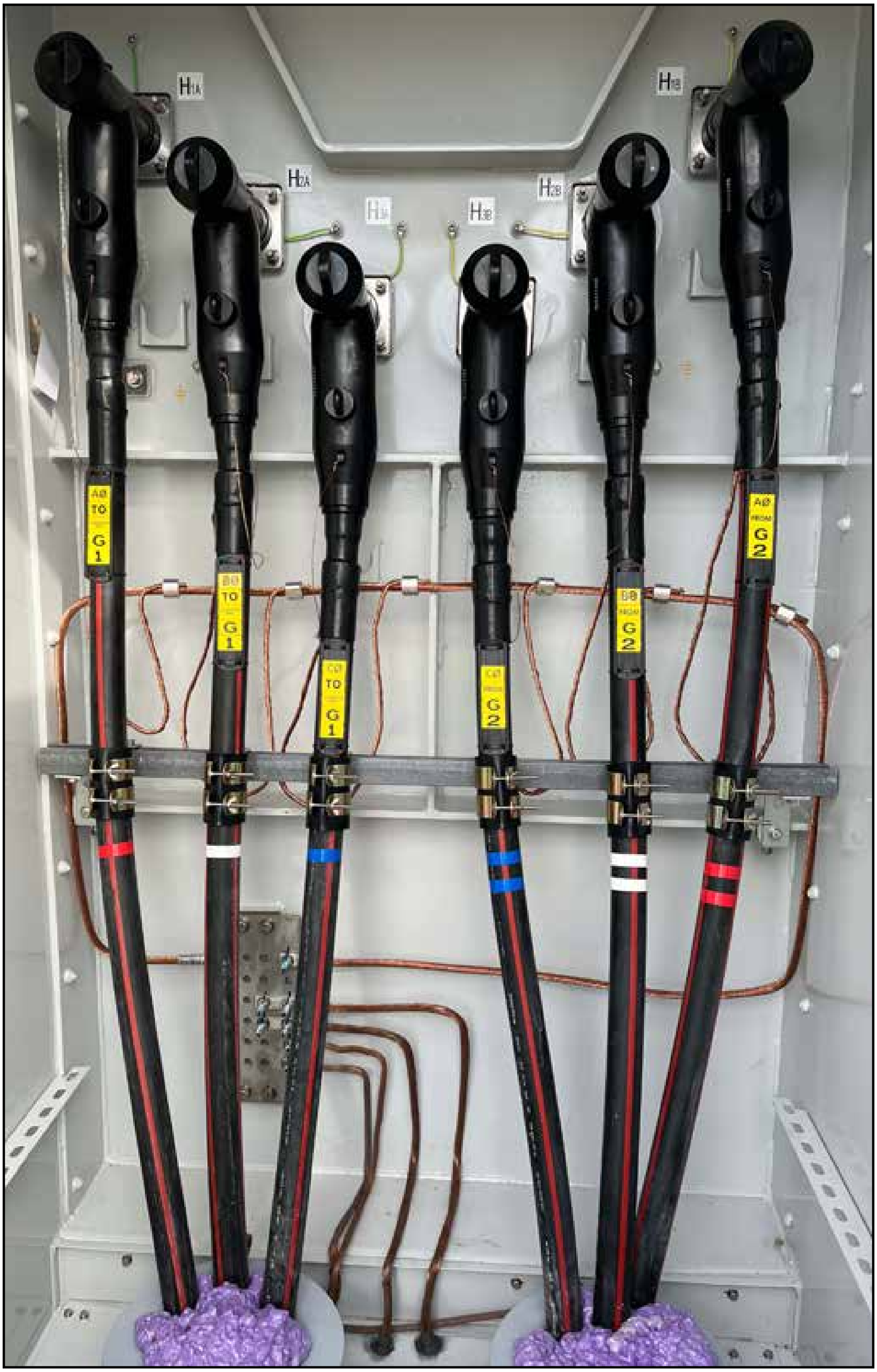
Below ground, buried cable marker tape is often placed 12–18 inches above URD cables or conduit with warning text such as "Caution: Buried Electric Line Below" to alert excavation crews that electrical lines are present.

In underground vaults, manholes, and handholes, it is standard to label ducts, phases, and splices, using durable cable tags that include circuit and feeder IDs. These tags serve as essential safety warnings and help identify cable racks, grounding systems, junctions, and protective devices.

Unfortunately, the same underground environmental conditions that affect cable systems can also have an impact on any installed signage. For example, moisture can cause painted and laminated signs to fade or delaminate. Temperature extremes can cause plastic signs to become brittle or warp. Exposure to chemicals can also degrade plastics and coatings.

All these factors make it essential for utility signage to be made from materials designed for long-term outdoor or underground use.

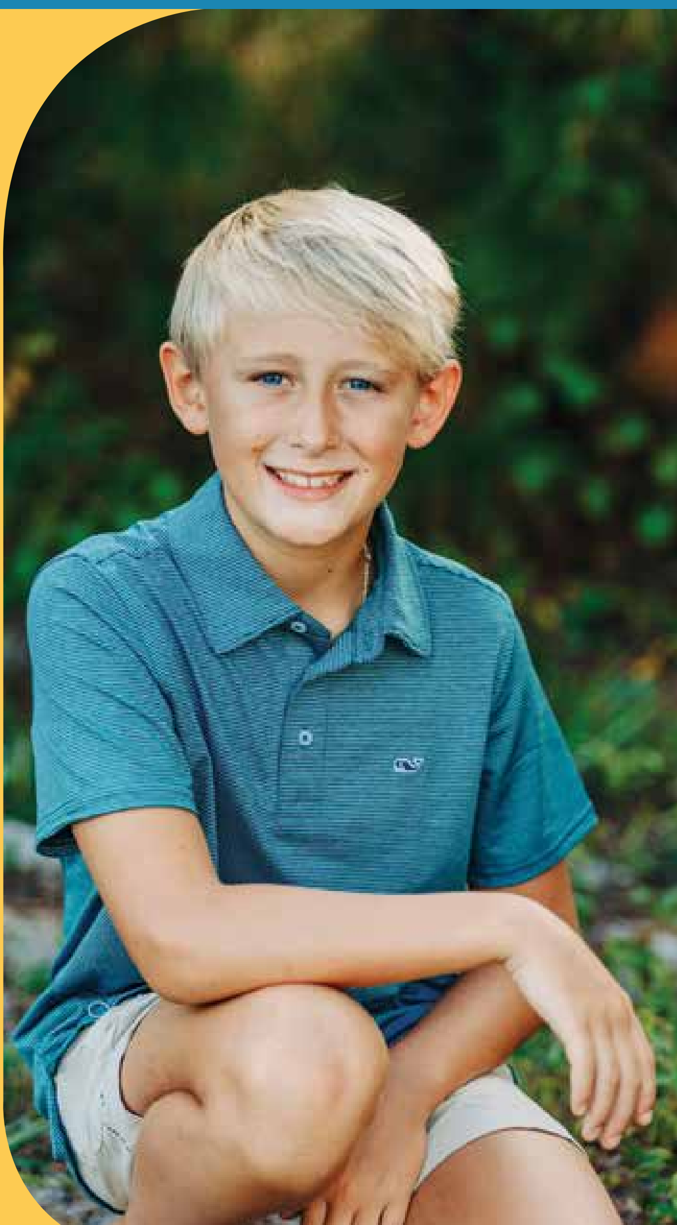
One of the most common options are write-on tags, which allow users to add information using Sharpies, pens, or pencils on materials like plastic, paper, metal, or coated cardboard.



Despite their simplicity and convenience, write-on tags have notable limitations. Handwritten information is often illegible and can smudge and fade over time. In addition, only some write-on tags are designed specifically for harsh environments.

A better solution is high impact polyolefin plastic products like the EVERLAST® brand from Tech Products. The company offers a range of identification products for electric and gas utilities, telecommunication and cable companies, OEMs and pipeline companies.

EVERLAST cable tags and markers display text or pictograms that are permanently embedded through the entire thickness of the substrate. UV stabilizers and antioxidants are added to provide



complete protection and weather resistance in all climates. The polyolefin plastic is impervious to sun, wind, rain, humidity, salt water, fumes, and acid/alkali solutions.

The tags and markers are not painted or screened but instead designed with solid black polypropylene characters permanently embedded into the substrate. Custom wording, logos, and a range of color options are available.

To speed the process of locating and isolating the exact URD cable or urban feeder during a fault or outage, the EVERLAST line includes phase markers in 1” and 3” sizes that indicate the phase (A, B, or C) of each line.

When close-up reading is required in tight or confined spaces, miniature markers with raised, 3D characters, called FastTags by Tech Products, Inc., remain legible even in low light, oily, or dusty environments. The raised 3D characters are hot stamped with high quality UV stable foil and are nonconductive and non-corroding.

Underground Cabling Grows

Today, demand for underground electric cabling is only growing. Dense urban cores and downtown districts rely on underground networks because real estate is scarce, outages and safety incidents carry high consequences, and aesthetics matter.

Regions exposed to severe weather and wildfire risk, including parts of California, Florida, and Hawaii, increasingly place distribution feeders and laterals below grade to reduce tree contacts and wind-borne faults. Planned communities, campuses, and industrial parks frequently specify “no-pole” covenants.

Given the increasing adoption of underground systems and with the stakes so high to quickly restore power, utilities need to effectively utilize industry best practice signage, tags, and markers to help technicians quickly and safely identify and resolve any faults.

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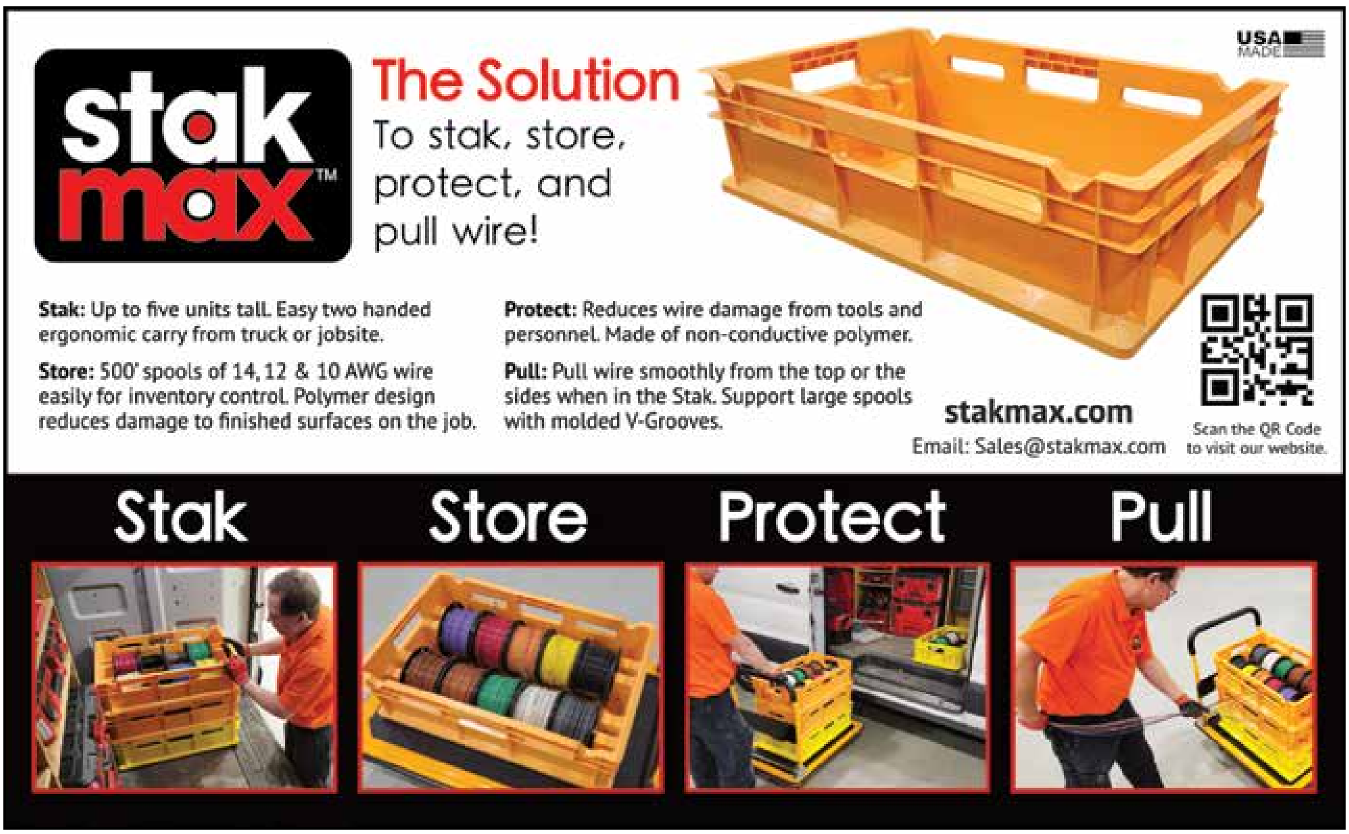
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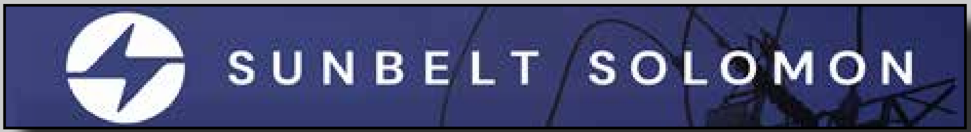

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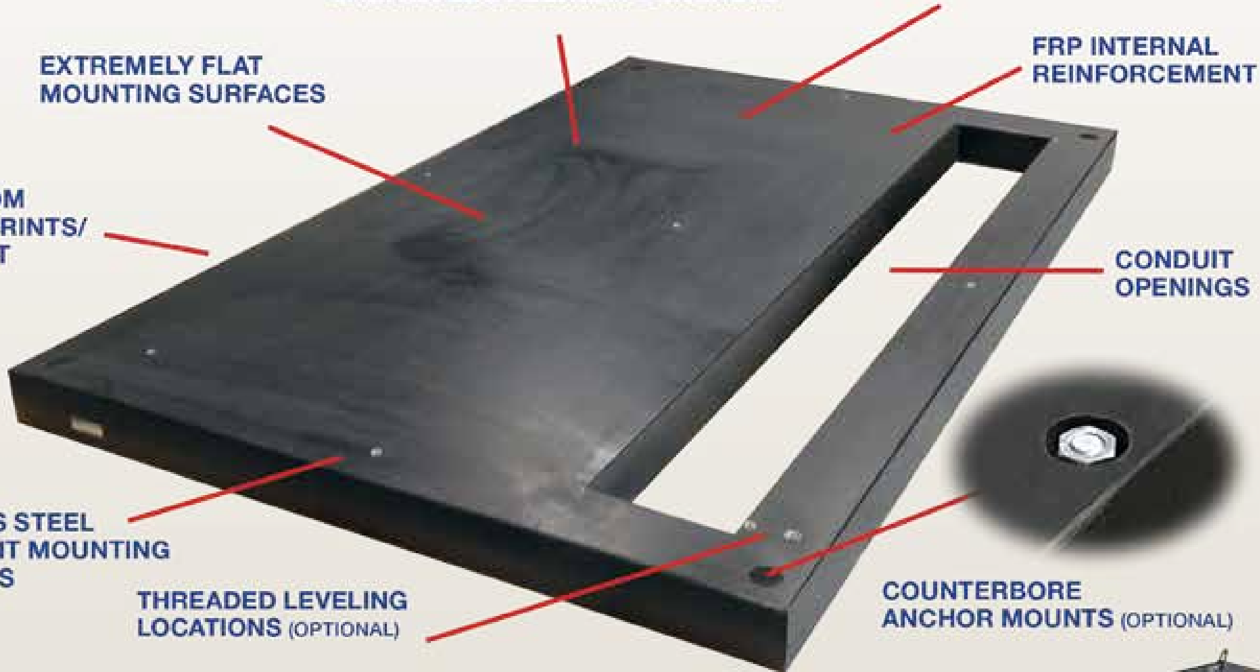

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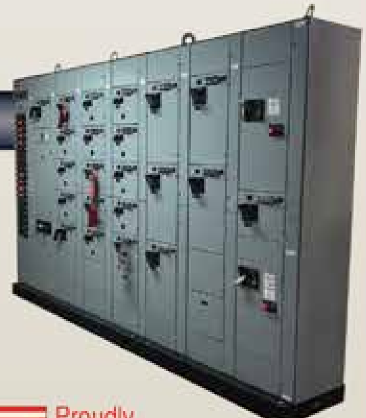

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