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More than Motors

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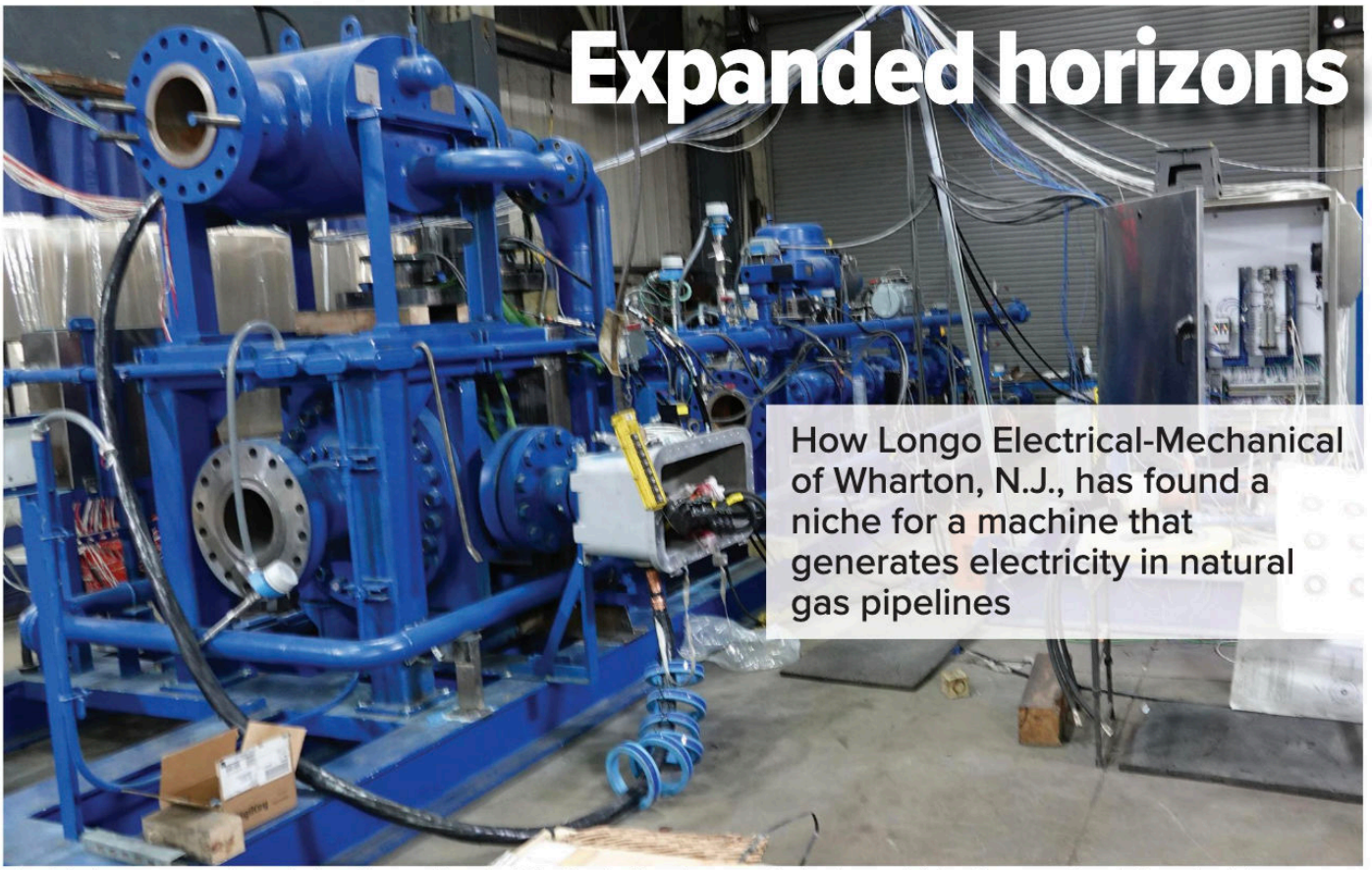

How Longo Electrical-Mechanical of Wharton, N.J., has found a niche for a machine that generates electricity in natural gas pipelines

The full size, scope, and complexity of Longo Electrical-Mechanical's turboexpander begins to sink in when one views it from the side.

By Charlie Barks, *EA* Managing Editor

WHARTON, N.J. – Twenty-five years since our last check-in, Longo Electrical-Mechanical has grown to great effect. Development of a turboexpander with its sister company Anax Power has been a major factor in this consistent growth.

We talk about family business a lot in this magazine. The word *innovation* also gets featured often, and we make an effort not to throw it around lightly. For Longo Electrical-Mechanical, the East Coast powerhouse in its third generation of success, both family and innovation have spoken for themselves. We featured the company 25 years ago *(*"Lessons from Longo" by Joseph V. Barks, in the March 1999 *EA)* and its progress during the quarter-century elapsed since is a useful model for how to succeed. Longo has epitomized its "line to load" tagline while diversifying to become one of the largest privately owned service operations in the country, utilizing four locations in three states to make an impact across the entire country and beyond.

A third generation at the helm

Nowadays, the spark at the company is Joe Longo, who represents the third generation of its namesake. His experience, rooted in an impressive education and a dedicated work ethos, is buttressed by innate qualities of self-confidence and interpersonal skills that steer the company's success. Joe has a Harvard degree, but he isn't pretentious. He's CEO of Anax, which he founded, but he mentions it offhandedly. He's someone who has macro-goals in one eye while he checks in on a sick-leave employee with the other. And perhaps most relatable to the *EA* audience, he speaks of the company's history with a fondness for his father.

When his grandfather John started the company in 1947, the operation had a single location with limited square footage. Now, Longo has its headquarters in Wharton, N.J., along with facilities in Bensalem, Pa., and Linden, N.J., topped off by an office in Manhattan. And speaking of expansion . . .

The company's latest innovation (which is primarily an Anax product) is a state-of-the-art turbo expander (the blue machine featured on this month's cover of *EA*) that generates electricity in natural gas pipelines. Turbo expansion is an old technology being applied in a unique way. Also referred to as *turboexpanders* or *expansion turbines,* these devices are essentially centrifugal or axial-flow turbines through which a high-pressure gas is expanded to produce work that is often used to drive a compressor or generator.

Because work is extracted from the expanding high-pressure gas, the expansion is approximated by an isentropic process (i.e., a constant-entropy process), and the low-pressure exhaust gas from the turbine is at a very low temperature – 150°C or less, depending upon the operating pressure and gas properties. Partial liquefaction of the expanded

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Three generations of family business: Joseph Longo Jr. helps his nephew, Stephen Malec, imprint his hand in the cement at Longo's Wharton facility during its opening in 1996, while Joseph Longo Sr. and Michael Longo watch. — Longo Electrical-Mechanical photo

EXPANDED HORIZONS continued from previous page

gas is not uncommon.

Turboexpanders are widely used as sources of refrigeration in industrial processes such as the extraction of ethane and natural gas liquids from natural gas, the liquefaction of gases (such as oxygen, nitrogen, helium, argon, and krypton) and other low-temperature processes.

Meet the turboexpander

Turboexpanders currently in operation range in size from about 750 W to about 7.5 MW (1 hp to about 10,000 hp). They are usually designed for the most demanding conditions, including offshore marine environments, harsh desert or cold weather locations, outdoor unprotected installations, and unattended sites.

A turboexpander is a rotating machine equipped with an expansion turbine that converts the energy contained in a gas into mechanical work. It operates similarly to a steam or gas turbine, but with a distinct purpose: It expands the gas stream for its own sake, and mechanical work is generated as a by-product. Most turboexpanders are used in conjunction with compressors or generators, where these devices serve as a sink for the expander's energy. Globally, there are at least tens of thousands of pressure regulating stations that can offer applications for turboexpanders.

The ATE-500, as it is labeled by Anax Power officially, harnesses wasted energy in natural gas regulating stations to generate clean electricity. It is an innovative, efficient addition to the existing natural gas infrastructure that provides clean power to energy-intensive manufacturers, independent power producers, natural gas pipeline companies, and more.

Here's how it works: Inlet gas is directed through a pre-heater for stage one of the process. Gas from the inlet side of the turboexpander pressurizes oil-free, enclosed magnetic bearings that don't require shaft seals.

Next, it moves to the inter-heater, where staged liquid-to-gas heat exchangers control system and gas temperature, avoiding issues such as gas condensation.

During stage two, as the inlet gas spins the turbine, it expands to the necessary outlet pressure. Overall, you have a dual-staged gas expansion using twin turbines operating at up to 22,000 RPM, which are shafted to a permanent-magnet motor that powers a generator.

A traditional Joule Thompson valve "wastes most of the energy," Joe Longo explains, "so what we do is run it through the turbo expander. The gas expands, yielding a pressure drop. It spins a generator at 15,0000 RPM on magnetic bearings. Each unit is ½ MW of power; they're modular so you can add units. What do you do with that power? Utilities don't make it easy to put it on the grid."

The valve Longo refers to concerns the Joule-Thomson effect often present in thermodynamics.

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The many uses of turboexpanders

For background, let's consider an overview of common applications for turboexpanders, with help from the American Society of Mechanical Engineers (ASME):

Cryogenics, Air Separation Plants:

> Turboexpanders play a crucial role in cryogrenics and air separation facilities. These plants aim to separate air into its primary components (nitrogen, oxygen, and argon) by fractional distillation.

> The turboexpander produces the necessary low-temperature (cryogenic) refrigeration for the fractional distillation and liquefaction of air, achieving temperatures as low as -196°C.

Natural Gas Industry. In this industry, turboexpanders are widely used for two main purposes:

> Liquefaction ('LNG' plants): Turboexpanders are essential components in natural gas liquefaction processes. They extract energy from the gas stream, driving down temperatures and enabling liquefaction.

> Dewpoint Control: Turboexpanders help control the dewpoint of natural gas by reducing its temperature. These machines are highly efficient refrigeration devices, achieving temperature targets by extracting substantial amounts of energy.

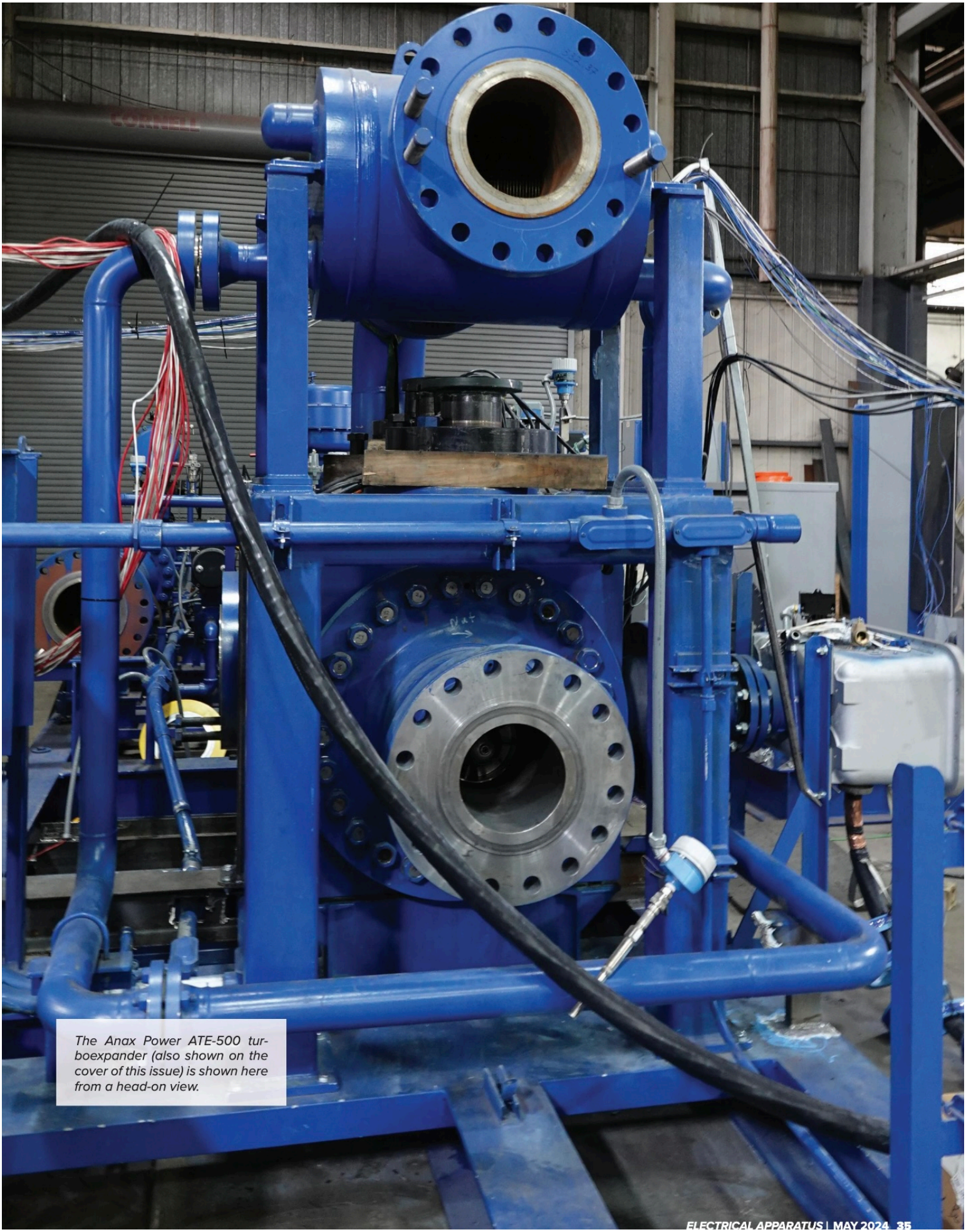
Petrochemical Industry:

> Ethylene Plants: Turboexpanders find applications in ethylene production plants. They assist in cooling and refrigeration processes.

> Refrigeration: Turboexpanders are used for refrigeration purposes in various petrochemical processes.

> Power Generation: Some petrochemical facilities utilize turboexpanders for power generation.

In summary, Turboexpanders are versatile machines employed in cryogrenics, air separation, natural gas liquefaction, ethylene production, and other critical processes. Their ability to change the state of process gasses efficiently by extracting energy makes them highly useful in various industries. — *CB*



The Anax Power ATE-500 turboexpander (also shown on the cover of this issue) is shown here from a head-on view.

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This describes the temperature change of a real gas or liquid (as differentiated from an ideal gas) when it is forced through a valve or porous plug while keeping it insulated so that no heat is exchanged with the environment. This procedure is called a *throttling process* or *Joule-Thomson process.* Most liquids such as hydraulic oils will be warmed by the Joule-Thomson throttling process.

How turboexpanders are used

The gas-cooling throttling process is commonly exploited in refrigeration processes such as liquefiers in air separation industrial process.

Compensators used in the turboexpander act as "big slinkies," according to Longo and his engineering team. "They're like big slinkies. You have to isolate the generator so that it doesn't cause stress." 15,000 RPM is used as a benchmark: "If you are above that at all, it can be thrown off and won't run smoothly."

Longo's efforts reflect a changing world, as Michael explains further. "We designed a system whereby a co-located data center– literally in a shipping container that we bring to the site - consumes the power from the ATE." According to Longo, this system can do everything from bitcoin mining to provide processing power for AI. Anax heralds a data center as "the most cost effective, efficient application for the ATE." Using a data center consumes the power behind the meter, avoids connecting to the grid, and circumvents burdensome regulatory procedures that can delay projects by years and cost hundreds of thousands of dollars. The data center also generates valuable waste heat that offsets heat loss in the pressure letdown process.

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Longo's Wharton facility provides in-shop maintenance and repair services on up to 15,000 hp motors (rewind/redesign), 30 MW hydrogenerators, and 100 MW turbogenerators.

Longo has been working on the turboexpander since roughly 2017. The company has plans for the first of these to be deployed sometime this year, and the company contends that multiple sites around the world – from the Middle East to America – have expressed legitimate interest. "The C-suite guys are all over it," according to [Joe] Longo, referring to the executive-level managers within a company. C-level members determine the execution of a company's established plans and policies; as Michael Longo puts it: "pipeline executives love this technology, but site operators are sometimes resistant to change." Another major incentive: 30% - 50% investment tax credit depending on project location and how much domestic material used. Also, clean energy applications are a big part of these efforts:

The ATE-Electrolyzer uses reliable, clean power to produce H_2 for pipeline blending. Benefits can include a higher capacity factor (>90%) than other green H_2 sources like wind or solar (<40%); the elimination of project-killing storage and transportation costs for H_2; qualifies for the same clean-energy incentives as traditional green H_2; and distributed production that can allow for incremental H_2 blending to test the impact on pipelines up to 20%.

Other applications for the turboexpander are resistive heating and the power grid. Consuming the ATE's power in a resistive heater can enable pipelines to offset their Scope 1 and Scope 2 emissions at pressure-regulating stations. These super-efficient heaters use clean electricity to offset heat lost in the gas expansion process and eliminate the need for inefficient, CO_2-emitting, natural gas-burning line heaters.

ATE's power can also be run through a transformer and put onto a grid. While simple to execute, this use case carries regulatory and economic obstacles. It also does not provide useful waste heat like the other use cases.

Independence feeds innovation

Longo Electrical-Mechanical and Anax Power both operate out of the Wharton offices, with Longo serving as a proverbial incubator for Anax, but both often have specialized products and goals. Both contributed to the engineering, built and assembled the turbo expander, and tested the skid. All programming, instrumentation, control, and testing were performed by Longo as well. This speaks to the sophistication

of their operation: two disparate companies coexisting and developing together, and using the experience of the original company to inform and improve the newer, higher-technology products offered by the second company.

One unique aspect of Longo, given its family roots and long history, is that it has stayed independent from big buyers while many comparative service centers have been bought out over the past ten or so years (think highly respected and profitable outfits such as Evans, Tampa Armature Works, now both owned by Integrated Power Services). Regarding this, Joe says, "We're one of the only companies that doesn't want to get bought out by a private equity firm, apparently."

A broad view of the shop floor at Longo's Wharton, N.J., facility.

Longo's business ensured it had the wind at its back in the early 2000s when significant developments were happening in that sector. By founding the North American Wind Service Alliance (NAWSA), which contains a number of the prominent, larger service center operations, Longo was able to diversify its offerings and create a valuable network for the wind power service industry. NAWSA, which originally included companies like Wazee, H&N (Rocky Mountain reps), Evans, and Kurz, is the only integrated service network in North America serving the wind generation industry with diagnosis, replacement parts, uptower repairs and restoration of wind power generating capacity.

NAWSA began as a group of 10 established companies with extensive wind generating experience. These original ten companies were:

Wazee Crane Services of Denver; Evans Enterprises of Oklahoma City; Kurz Industrial Solutions of Neenah, Wis.; Jay Electric of Birmingham, Ala. (shout out to Chase Fell!); Sloan Electric of San Diego; H&N Electric of Pasco, Wash.; Trico TC-Wind of Litchfield, Minn.; and Longo itself. Wazee and H&N have since been absorbed into the Timken family of businesses following an acquisition in 2013.

Longo's capabilities go well beyond the turboexpander. Walking the floor at the Wharton facility takes you past monster generators as well as pumps, gearboxes, and more. The facility is home to multiple high-capacity cranes (up to 25-ton) for lifting some of its heavier line-to-load equipment for servicing.

For a company with a rich history that has seen it grow to around 80 employees today, recognizing the industry's needs remains as important as it was when *EA* last visited 25 years ago. "It's still really a people business," Longo says. "If you screw up, they'll remember it forever." Given its 75-year résumé, this doesn't seem like a company that will be screwing up any time soon. **EA**

Two large motors after a rewind and refurbishment at Longo's Wharton facility.